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THE

TEA QUARTERLY

THE JOURNAL

OF THE

TEA RESEARCH INSTITUTE

OF CEYLON

Edited by

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Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE.

St. Coombs, Talawakelle.

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NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

EDITORIAL.

TEA RESEARCH INSTITUTE CONFERENCE.

The next Tea Research Institute Conference will be held at St. Coombs on Friday and Saturday, February 24th and 25th, 1939. Further details will be announced in due course.

META-BRAN BAIT.

In Part II of *The Tea Quarterly*, June 1938, a reference was made to the use of a poison-bait composed of Meta solid fuel and Bran against snails and slugs. Since that date one or two reports have been received from planters who had carried out trials of this material and these are reproduced below:—

(1) Meta-Bran bait mixed at the rate of $\frac{1}{2}$ oz. Meta per lb. of Bran was distributed at 15 feet intervals. The results obtained were as follows:—

Field	Quantity of Meta used	Number of Snails killed
8	2 oz.	2,842
8	2 ,,	4,221
2	1 ,,	1,844
9	1 ,,	1,228
9	$\frac{1}{2}$,,	941
2	1 ,,	2,606
	$7\frac{1}{2}$ oz.	13,682

(2). "Some time ago I planted out in tea small Grevillea plants in supply baskets and in certain places these were eaten off immediately and as there were no Kalutara Snails in this part of the estate, I was at a loss to know what had done it.

Since then I have experimented with Meta and Rice Bran in my garden with excellent results against snails and slugs. A few days ago I planted out further supplies of very small Grevillea plants in the area where the former ones were eaten off and put a small quantity of Meta mixture in each basket; the following day I examined a number of these baskets and found all the plants intact but anything from one to three slugs or round soft shelled snails dead inside, which but for the Meta would have eaten up these plants again."

It is understood that the amount of mixture used in each basket was a ball about the size of a tea seed.

TARING OF TEA CHESTS.

With reference to the recommendation made in the last issue of *The Tea Quarterly* in regard to the use of strip iron for taring tea chests, favourable reports have been received from London. A local correspondent also writes to say that the method has been found extremely convenient. Cost has been reduced by buying the material in long strips and cutting and holing these on the estate. By this method the cost amounts to about $2\frac{1}{2}$ cents per chest.

ROLLING.

In the present number will be found an article by Mr. Lamb describing certain experimental work on rolling which has been in progress in his Department. Since the article was completed the experimental invoice of "Clivemeare" tea referred to has been sold in London and a certain amount of information is now available as to how tea of this type is regarded by the London Market.

For the purpose of this test, two invoices of tea were sent to London, one, "TRINOR," being manufactured on orthodox lines while the second, "TRIMEARE," was manufactured by the Clivemeare process. Each system of manufacture was carried out on alternate days so that any variations in weather conditions or leaf were averaged out and the two invoices could, therefore, be regarded as closely comparable. It may be noted in passing that both invoices were made during the height of the south-west monsoon, so that the leaf available was generally of lower quality than normal.

Each invoice comprised 54 chests, "TRIMEARE" consisting of B.O.P., F.P., B.O.P. Fannings, and Dust, while "TRINOR" consisted of B.O.P., F.P. and B.O.P. Fannings, the amount of dust being too small for packing the necessary number of chests.

Details of valuations by the London Brokers and sale prices realised are given below:—

	Invoice 18. "TRINOR"			Invoice 17. "TRIMEARE"		
Grade	Lbs.	Valuation	Price	Lbs.	Valuation	Price
B.O.P.	3750	1/3½	1/3	3300	1/3-1/3½	1/4¼
F.P.	1260	1/2½-1/3	1/2½	570	1/3	1/2¾
B.O.P. Fgs.	1080	1/3½	1/3¾	996	1/3½-1/4	1/4¾
Dust		—	—	600	1/1	1/2
Sale Average			1/3			1/4

It will be noted that the actual sale did not entirely follow the Broker's valuation. In the latter, "TRINOR" B.O.P. was preferred on grounds of quality to "TRIMEARE," though infusions of "TRIMEARE" were reported on as redder and more even and the liquors of the latter as redder and stronger. The "TRIMEARE" B.O.P. was, however, considered rather soft and lacking in fresh briskness. Buyers, however, seem to have paid less attention to this factor and to any defects in the appearance of the "TRIMEARE" dry leaf, and gave a preference of $1\frac{1}{4}$d. to the B.O.P. of this invoice, while the invoice as a whole averaged one penny above "TRINOR."

Further enquiries amongst the Trade elicited the following opinions:—

(1). "TRIMEARE" preferred on account of its strength and roundness.

(2). "TRINOR" preferred all the way and "TRIMEARE" liquors considered 'peculiar.' The dry leaf of "TRIMEARE" was also adversely commented on.

(3). Preferred "TRINOR."

(4). Bought "TRINOR" B.O.P. Fannings for 1/$3\frac{1}{2}$ and bid 1/$4\frac{1}{2}$ for "TRIMEARE" B.O.P. Fannings.

(5). Generally agreed with broker's valuations and with opinion expressed in regard to softness in "TRIMEARE" B.O.P.

The general position may, perhaps, be summed up in the following Broker's Report:—

"We think you will agree therefore that, although in terms of price there is little doubt that the "Trimeare" teas were more valuable, there is a significant difference of opinion between representative sections of the Trade as regards the merits of the two types of teas. Some buyers are prepared to ignore any tendency towards softness if better strength and redness are obtained, but we cannot help feeling ourselves that any accentuation of this characteristic would be dangerous as it would leave the keeping quality of these teas seriously in doubt. At the same time we think that it would be imprudent to judge results too much by one sale of an experimental invoice of a mark unknown in this country, and you are better able than we are to form an opinion as to the likely success

of the Clivemeare process if carried out in a factory other than St. Coombs, without all the expert care and attention that has been given to it."

The actual sale shewed that there was a definite demand for tea of the Clivemeare type, though it is at present unknown whether large quantities of such teas would be absorbed.

It seems desirable that further trials of this process should be carried out and the question is now under consideration.

ROLAND V. NORRIS.

ADDRESS TO THE CEYLON ASSOCIATION IN LONDON*

C. H. GADD.

It is usual, I think, for officers of the Tea Research Institute, when addressing this Association, to speak mainly of the work carried out in their respective divisions. My division is concerned primarily with the diseases of the tea bush. As, however, the future of the Institute is shortly due for consideration, I propose to speak more generally of the Institute's work instead of confining my remarks to pathological subjects.

On July 1st, 1926, the nucleus of the scientific staff of the Tea Research Institute entered a rather bare, empty bungalow in Nuwara Eliya which then became its temporary headquarters and laboratories. On that day a new organ, or gland, was grafted on to the body of the Ceylon Tea Industry. It was somewhat in the nature of an experiment, though one which had been successfully performed on other industries with beneficial results. A great part of the industry looked upon that experiment with confidence, but there was a small minority which regarded it possibly as mere foolishness from which no good could come — like experimenting with monkey gland treatment on a body showing no sign of senility.

As with most such experiments, it was watched very closely at first by all interested parties. That interest often became vocal in the form of a question "What is the T. R. I. doing?" In many cases the tone of voice implied genuine interest, but in others it supplied an emphatic answer as well. Nowadays that question is rarely heard — not because interest has waned, nor because our quarterly journal and other publications, conferences and addresses to Planters' Associations supply at least a part of the answer, but because the Institute has become accepted as an integral part of that great body, the Ceylon Tea Industry. So long as a man is healthy he does not stop to ask what is the condition of his heart or digestive organs. Such questions arise mainly at the onset of illness.

* An address given by Dr. C. H. Gadd, Mycologist of the Tea Research Institute of Ceylon, to members of the Ceylon Association in London and their friends in the Council Chamber of the Rubber-Growers' Association (Inc.), 19, Fenchurch Street, London, E.C.3, on Monday, 13th June, 1938.

That attention is being directed towards the Institute at present is not due to any suspected unhealthy condition of the Institute. As you know, the Institute is maintained by the proceeds of a cess levied on the Industry, and that cess is fixed by Ordinance. The amount of that cess is this year due for reconsideration. The purely financial aspect of that question has been presented to you in a memorandum by the Director, so instead of elaborating that aspect I propose to say something of the benefits derived by the Industry from that expenditure.

The main functions of the Institute, as its name implies, is Research; yet it serves other functions too, which are rather apt to be overlooked. The Director at various times has reviewed the work of the Institute. Such reviews have been concerned mainly with the research activities. To-day I should like to emphasise some of its other functions which are apt to be overlooked or, perhaps, accepted without fully realising their important value.

Before joining the staff of the Institute on July 1st, 1926, when the temporary laboratories at Nuwara Eliya were first opened, I was on the staff of the Agricultural Department at Peradeniya for a period of nearly six years, and so can speak from personal knowledge of the relationship between science and tea culture both before and after the establishment of the Tea Research Institute.

When I joined the Ceylon Government Agricultural Department, its main divisions which had close connection with the Tea Industry were the mycological and entomological laboratories and the Experiment Station at Peradeniya. Consequently, from the scientific side, more was known about the diseases and pests of tea than about the tea bush in health. There was also a steadily growing demand for more scientific research from the planting community. The direction of that research was not clearly enunciated, but it was evident that there was plenty of scope for useful work in the directions of manufacture, manuring, pruning and other field operations. Although such subjects were often discussed at Estate Products Committee meetings, there were no members of the staff especially delegated to study those particular problems solely.

During my period of service with the Agricultural Department, there was a marked increase of its activities and in the scope of its work. That extension was mainly, if not wholly, for the benefit of what may be termed "native agriculture;" and the major industries profited little thereby. It became evident that if the Tea Industry was to get the scientific help it desired it would have to finance its own Institute. And so the Tea Research Institute came into being. Since then Ceylon has been granted a new Constitution

which has now been operating for some few years. There can be no question that, during this period, the Government agricultural work has exhibited an even stronger bias towards native cultivations. This bias is justifiable no doubt and may in part be due to the existence of separate research stations for tea, rubber and coconut. To what extent the Ceylon Agricultural Department, under the new conditions with increasing demands for attention to villagers' agricultural problems, could have assisted the Tea Industry, particularly during the slump, must be left to your own judgment. The Tea Research Institute, however, receives no subsidy from Government although tea is the most heavily taxed industry in the Island.

When the Institute commenced operations it was realised that considerable scientific work had been done on the pathological side and that precedence would have to be given to the purely agricultural (including soil and field experimentation) and manufactory problems. Consequently, the Agricultural and Biochemical Divisions, together with the Physiological Division which was instituted later to study such problems as pruning, propagation and selection, became, and still are, the largest. Although the Institute is divided into departments for administrative purposes, it is better to regard the staff as a whole as a team working for a common end. Each man of that team is now a specialist whose particular study is some aspect of the tea bush, and if he claims a knowledge of any crop plant, that plant is tea.

When the staff began work, its main problem was not to decide what particular piece of research work each member should begin on, but how best could the advisory work be handled. Information had to be collected and sifted to separate the grain from the chaff. That preliminary work disclosed the tremendous gaps in our knowledge and these had to be filled, temporarily at least, as quickly as possible. Had there been no gaps, there would have been no need for research, but the gaps were only too evident and many still are. This early advisory work was essentially team work and each member of the staff did his best to make advice emanating from the Institute the best possible. We also made a point when formulating advice to give the reasons on which it is founded. Advisory work must be based on the results of research investigations, but is probably not generally recognised how much research has to be carried out solely for immediate advisory purposes. For the want of a better name I would call this "uncompleted" research — uncompleted because isolated points are investigated as the need arises and opportunity occurs. In the course of time these isolated investigations may be fitted together. Nevertheless they are of vast importance in so far as advisory work is concerned.

In addition to "uncompleted" research I would also mention "Confidential Research." By this I mean work, the results of which are not published in our general publications. Examples are "Factory Hygiene" and "Foreign matter in Tea." Although the results of such investigations are not published in our Journal, they form an important basis of advisory work.

I think it can be fairly claimed that the Institute early gained the confidence of the planting community in Ceylon and also continued to earn that confidence. The steady increase in advisory work in all divisions affords some proof of that statement. The extent of advisory work cannot be measured entirely by the number of letters written. The articles in *The Tea Quarterly* tend to eliminate a number of letters on those subjects, and much is done by discussion. It is generally recognised that the Institute is now a source of reliable information on all matters concerning tea culture. We do not claim to be able to answer all questions definitely, nor do we claim to be infallible, but we do maintain that the opinions we express are unbiased, in so far as a human being can be entirely unbiased, and that they are based on a careful study of the subject.

As a direct consequence of advisory work and the regular issue of publications like *The Tea Quarterly* which are widely read and closely studied, the Institute has become an important educational factor. It may not be necessary for me to elaborate this point, but I should like to mention one or two points. Our work with the small-holder is essentially educational, and the beneficial effect of such instruction is to be seen in a large number of village gardens. When I say that the Tea Research Institute has become an educational factor, I do not mean to imply that the Institute is teaching the planter the fundamentals of his job, but I submit that the practical planter's outlook to his job is gradually changing. He is not so ready to take *ex cathedra* statements as gospel. He demands and is critical of the data on which the conclusions are based. At one time, I was of the opinion that the only part of a technical paper on an agricultural subject which was carefully read by the planter was the summary of conclusions. That is not the case now. The reasons for the conclusions have assumed greater importance. In other words the outlook is becoming more scientific.

One result of this is a growing tendency of planters to discuss their ideas and intended experiments with the scientific staff before putting them into operation. In this respect the staff is often able to give assistance. Sometimes, the scientist can show that the idea is based on fallacious principles and then, I imagine, the agents and directors hear little more about it. But when the staff approves

the idea as worth-while, the suggestion is put to higher quarters with more confidence and the work is undertaken with greater enthusiasm. In my experience the planting community of Ceylon has always been progressive. The more scientific outlook is, however, rationalising the procedure more. Possibly the best examples of this rationalisation are to be found in factory work.

Now I should like to say a few words concerning controversy. To put it quite baldly I would say that controversy is a function of the Institute. This may appear a somewhat startling statement to make, so for a few minutes I would like to elaborate this statement.

Scientific progress is very largely dependent on criticism. You will find that a mass of controversy has centred round all great scientific theories. I need, perhaps, only mention two — Darwin's theory of evolution and Einstein's theory of relativity. The former and older one has not yet entirely passed the controversial stage while the latter I think has. It really amounts to this: a theory is not completely proved until it can be shown to account for all relevant data. In a way the importance of a subject can often be roughly estimated by the amount of controversy centring round it. The amount of controversy should not, however, be measured by the heat evolved. That is no criterion. What is true of major work is also largely true of minor investigations. The results must withstand criticism.

Fortunately, the main mass of criticism does not reach the lay ear. Nevertheless it exists as it should do. It is likely to occur first in the Institute itself, secondly between Institutes working on the same crop, and lastly between what for convenience I would term "independent workers." It is criticism in the last category which is likely to reach the lay ear, particularly when the lay Press considers it worth featuring, and then it is called controversy.

I should like to illustrate these points with examples from my own division. The first is an example of criticism within the Institute. While carrying out investigations on a certain problem, I came across evidence which suggested a new explanation of the causation of a certain disease of tea known as Diplodia. I took my evidence and views to Mr. T. Petch who was then the Director of the Institute. It may be necessary to explain that the view regarding the causation of Diplodia disease which had held the field for many years, viz. that the cause was a fungus attack, had been put forward and published by Mr. Petch himself. My views were, therefore, a direct attack on his own work. It would have been a simple matter for him to have smothered my criticism at birth and to have instructed me to get on with the problems awaiting solution and not waste

time trying to upset views which had become accepted. That was not Mr. Petch's view of scientific research. I was told to go ahead. He watched my work with kindly interest and bombarded me with criticism, constructive and destructive. When my views were made public they had Mr. Petch's backing and support, and I doubt whether the planting community ever realised that those views had been controversial. My own opinion is that that work was the better for having to stand up to keen criticism, and I am deeply indebted to Mr. Petch for the kindly criticism he gave me on all occasions, particularly on those occasions when I found myself working along lines contrary to his own opinions.

The view I then put forward also indicated methods of preventing the disease which was causing considerable losses to low-country companies. Those preventive measures concerned pruning. That the methods of prevention were practicable and efficient have since been amply proved both by experiment in the physiological division of the Institute and by general experience in the field.

Controversy between institutes working on the same crop will in most cases be settled amicably and without much publicity. Differences of opinion can be smoothed out by further work on both sides to clear up the points under dispute.

It is the third type of controversy which often places the planter in a quandary, *i.e.*, when experts differ and their differences are given prominence in the Press. An example of this type occurred shortly after I joined the Institute when, at an Agricultural Conference, the Government Mycologist put forward views concerning the causation of root disease not only of tea but of practically all crops in the tropics. These views were directly contrary to those of both Mr. Petch and myself who had worked on root diseases of tea in particular. I considered it to be my duty to oppose those views immediately and to indicate that they had not the backing of the Tea Research Institute. This gave rise to a controversy which attained a good deal of publicity.

I sometimes think that some members of the planting community obtain a certain amount of enjoyment out of watching scientists disagree. In fact they will sometimes search for disagreement by sending specimens to two scientists for opinion. If the scientists agree well and good, but if they disagree and the advices differ I sometimes wonder what the planter does about it. It must sometimes happen that both scientists are right because the specimens submitted to each are not the same. One may be a case of Poria and the other of Ustulina, as I have known to happen. In that case both scientists were right and the planter merely perplexed.

But in the controversy we were discussing it was obvious that we couldn't both be right. Many planters found the position rather difficult. Here were two different views and advices. Which was he to follow? The estate agents and company directors no doubt have been somewhat irritated by that or similar experiences. Had there been no Tea Research Institute the Government Mycologist would have been the official adviser to the Industry and the difficulty might not have arisen, though I think there would have been wonderment as to why the causation of plant diseases should change with new appointments to a government post.

The then Government Mycologist's views were taken up by other mycologists elsewhere and further investigated. The present position is that in general his view has been abandoned as untenable, and the controversy is dead. In this case the Tea Research Institute fulfilled a function in preventing the Industry from following a line of action which would not have been to its benefit.

The safeguarding of the Industry in that way, I submit, is an important function of the Institute. Although the staff makes a specialist study of tea, it also follows the results obtained by workers with other agricultural crops to ascertain whether progress made there is likely to be applicable to tea. That such conclusions are not immediately accepted in no way implies criticism of the work in its relationship to the particular crop from which the data are collected, but it does afford a safeguard against the Tea Industry taking over results prematurely from workers on other crops. To take a simple case, the beneficial value of lime in general agriculture has been demonstrated amply, but we also know that if lime is applied to tea soils the effect is likely to be detrimental. A disease of tea seedlings known as "Bitten off" has been demonstrated to be due to the soil being insufficiently acid. The poor yields of tea in the surrounds of certain factories is largely due to the too liberal application of wood ashes from the drier furnaces which has much the same effect as lime in altering the soil reaction. Our observations in no way question the truth of the effect of lime on other crops, but we know that any generalisation concerning it should not be applied to tea. This example is, perhaps, of interest because at one time lime was recommended for use in the treatment of tea root diseases. That recommendation was based largely on a knowledge of the effect of lime on fungus root diseases of other crops, but, with an increasing knowledge of the tea plant and its diseases, that recommendation has had to be radically altered. We now know that lime has no value in the treatment of the common root diseases of tea.

Recently, a view has been put forward that diseases never attack a really healthy plant, and that if disease occurs, it is a warning that there is something wrong agriculturally. This view has been summarised in the one sentence "Pests in a sense are nature's inspectors or visiting agents." If that view is accepted as true for tea, the logical conclusion is that expenditure under the heading "Pests and Diseases" in the estimates of so many companies is sheer waste, because that expenditure is directed towards the removal and not the support of such useful agents. It is a view, however, with which I cannot agree, as, in my opinion, there is no true foundation for such a broad generalisation. I do not deny the importance of proper agricultural treatment and its value in the control of certain diseases, but I am absolutely convinced that such diseases as the Poria root disease can never be controlled by cultural treatment alone.

If a disease occurs and is reported from an estate, it does not follow that the cultural and manurial treatment of that estate is wrong or in any way deficient. In the majority of cases the incidence of disease in the tea fields has nothing whatever to do with the cultural policy. Diseases have not all a common causation, nor is there a universal method of eradicating disease. In my opinion, there never will be one. We may as well hope that plague and pimples, cancer and colds, typhoid and toothache will all yield to one common treatment. So long as tea is grown commercially funds will be required for the control of pests and diseases. Increased expenditure on cultural operations, manuring, etc. will never eliminate the necessity for direct attack upon the fungi and pests which cause so many diseases of tea.

When the Institute expresses an opinion in any way opposed to views expressed elsewhere, you may rest assured that the Institute has very good reasons for doing so and you will find that the Institute gives its reasons for the view it expresses. Nobody likes to be told that he is wrong and less still does he like to be proved to be wrong. That applies equally to an institute staff as to an individual and so, before the Institute enters a controversy, it very carefully considers the grounds for so doing and the risks to its reputation involved. If, however, the Institute failed to enter a controversy for fear of coming down on the wrong side of the fence the Institute would have failed in its duty.

If that view is accepted it will be obviously unfair to criticise the Institute for entering a controversy and disclosing relevant facts concerning the matter under discussion in its relationship to tea; still more unfair is it if the criticism is launched before the Institute is proved to be wrong. In such matters the Institute must express

its unbiased opinion without fear or favour from any section of the Industry. Again the Institute does not claim infallibility, but it does claim that its views are based on a specialised study of the tea crop and that such views are expressed in good faith for the welfare of the Industry.

I have here attempted to indicate some of the more important functions of the Institute other than research, functions which I think are apt to be overlooked when evaluating such an Institute. Research is the primary function of the Institute, but I think that that would have little value if it were completely divorced from other functions I have referred to here.

I have said very little about the work of the division of which I am in charge, but I should be pleased to answer to the best of my ability any specific questions you may wish to put to me concerning it or other work of the Institute.

Mr. Andrew Young enquired whether, during the last five or six years when it had not been possible to make liberal provision for cultivation, Dr. Gadd had discovered any increase in pests and diseases, and what positive steps the Institute advised for the treatment of the leaf disease which was now attacking Grevilleas?

In reply to the first question, Dr. Gadd said that there had been no noticeable increase in diseases generally or of any particular pest during the period referred to. More difficulty had been experienced, however, in dealing with a root-disease such as Poria in cases where the removal of affected bushes had been stopped through lack of funds.

To the second question, Dr. Gadd said there was no simple answer that could be given. The disease, so far as is yet known, attacked Grevilleas only and there was no risk of it passing on to the tea. Its distribution was curious, as it was more prevalent in the low-country and at the bottom of hillsides, with a tendency to vanish on the higher slopes; it was difficult to explain why it should pass out within such small changes of elevation. It reminded him in some ways of the first occurrence in about 1925 of Oidium in rubber which appeared on a number of estates spread over a wide area, since when there had been little increase in the area affected. Both diseases were, perhaps, controlled by some climatic condition impossible to define.

The only direct step possible was to remove the Grevilleas, but he did not consider such a course necessary immediately, as some trees were likely to survive attack. Spraying to kill the fungus was

a possible measure of control, but as this would mean a succession of sprayings during the year the cost would be prohibitive.

Fortunately, the disease had not as yet occurred in Uva, but mainly in the low-country where Grevilleas could be easily replaced.

Mr. Horner said that he had recently received information of an attack of the disease near Badulla.

Dr. Gadd said that he would like to verify the report personally before expressing any opinion, as mistakes had been made before through confusing this disease with another which kills isolated branches but is not a disease of the leaf.

The President enquired whether the newly discovered parasite, which seemed to be dealing satisfactorily with Tortrix, was spreading of its own accord?

Dr. Gadd replied that, when the first consignment of the parasite was received from Java, it was liberated on St. Coombs, but some time later appeared to have vanished. However, after a cage had been prepared to house a second consignment in the field, numbers of the original importation were found firmly established half-a-mile or so away. The indications were that it would not be necessary to depend upon artificial propagation.

Mr. Clifford Figg enquired whether there were any signs of Phloem Necrosis spreading from higher elevations?

Dr. Gadd replied that a careful lookout was being kept in other districts and before he left Ceylon it had been identified on an estate where the superintendent had known it 25 years, not as a disease, but as a condition of the tea. The spread of the disease had not noticeably increased, but only its intensity. Field evidence suggested that such spread as there was, was slow.

So far all attempts deliberately to infect bushes with Phloem Necrosis had failed.

In reply to an enquiry from Mr. Megginson, Dr. Gadd said this disease had not so far been found in young tea.

Mr. Masefield, referring to the research which it was proposed should be conducted into the quality of tea, pointed out the risk that, if chemists were asked to conduct such an inquiry, a formula might eventuate for synthetic tea or for giving to low-country tea the characteristics of the up-country product.

In reply Dr. Gadd said that the investigation into the quality of tea would not be a simple matter and would call for a high

standard of specialised chemistry. He was of the opinion that the results which would follow would be of help in manufacture, as it was impossible at present to follow the chemical changes which occur during the various stages of manufacture, and he did not consider that Mr. Masefield's fears were likely to be realised.

In expressing the thanks of the Meeting to Dr. Gadd for his interesting address, the President said that, at the start, the Institute had had to win the planter to new ideas for the formulation of which it was responsible.

Now that confidence had been won the Institute must bear the greater responsibility for giving young planters the right lead.

STUDIES ON THE ROLLING OF TEA.

J. LAMB.

During the past four years many references have appeared in *The Tea Quarterly* and in the annual reports especially, in the latter, to our research on the fundamental principles of tea rolling.

The work involved is long and tedious; this is not very surprising, considering that rolling experiments have been carried out in factories in all parts of Ceylon by superintendents of estates and teamakers for the greater part of a century without any very definite conclusions having been reached. Even in the same district, the methods employed may be very diverse in different factories; there are a multiplicity of types of rollers and battens, and the type employed in any particular case does not, in general, bear any relation to elevation or district. Everyone familiar with the tea industry is aware of many paradoxical instances in connection with manufacturing methods, machines, and results. Neighbouring factories with almost identical equipment may get entirely different results, old factories with obsolete equipment sometimes do well where new factories fail, and from time to time new machines come on to the market with a record of very successful trials and fail miserably in general practice.

In short, a research worker contemplating investigations on tea manufacture finds little to guide him on his way, and before he has conducted many experiments will become aware of the innate conservativeness of the tea trade of which he must be exceedingly wary.

Four years ago I found myself faced with such problems and since I did not possess any previous experience of the tea industry, I proceeded with an unbiased mind to study existing methods. It was perhaps fortunate that I had not received any prior instruction as such on tea manufacture because teamaking is a matter of many prejudices and to have acquired preconceived theories would have been a serious handicap. Experience gained from visits to factories in all parts of the Island led me to the conclusion that there was plenty of room for investigation of the principles involved in the use of the orthodox type of rolling machine. The ordinary roller appeared to have withstood the test of time in that, in more or less the same form, it dated back to the beginning of the industry in Ceylon and held its own against all new-comers such as the expressor, the C.T.C. machine and various forms of cutters.

Expensive machinery lying idle creates a lasting impression in the mind of a new-comer and does not encourage purely exploratory research and I decided to leave such matters alone at least until I had gained experience of existing methods. With regard to the use of rollers the only generally agreed principle seemed to be that it should be done in stages although there was no agreement about the length of each stage or roll, the pressure used for each roll, or on any of the other details of procedure.

The question then arose as to why the many hundreds, perhaps thousands, of experiments carried out by those engaged in the practice of teamaking had failed to give more exact information. It soon became obvious that, since under normal commercial conditions it was not usual to measure any of the mechanical constants, it was almost impossible to define any particular method of rolling. The utility of commercial experiments was therefore limited to the particular set of machinery on which they were carried out and, even then, the repetition of any particular set of conditions was often a matter of considerable difficulty. For instance, when I came to Ceylon, the actual pressure in terms of pounds weight had only just been measured and I assisted in what we believed to be the first attempt in Ceylon to measure the actual power consumed by a tea roller under working conditions. How therefore could any previous rolling experiments have been defined in such a way as to give results of general application?

I was, however, fortunate in arriving at what appeared to be the dawn of the scientific approach to rolling problems and also in having small-scale experimental rollers at my disposal, and one of the first tasks was to get these equipped with means of measuring the most important mechanical constants.

A variable speed electric motor with Kilowatt recorder was installed to drive each roller and, after a number of tests with spring pressure, the springs on the pressure caps were discarded and a system for adding weights to the cap was devised.

The outcome of these changes was that every experiment could be defined in terms of:—

1. Time.
2. Speed of roller.
3. Pressure applied in pounds weight.
4. Time and interval of application of pressure
5. Total power consumed.

Furthermore, the Kilowatt recorder would give an exact record of variations of power during each rolling period which could be related to other records of pressure, speed, load, etc. It was, therefore possible to keep an exact record of all the principal physical conditions of every experiment which could be repeated accurately whenever desirable.

Some considerable period elapsed before the new equipment was complete but since that time no effort has been spared to expedite our investigations on rolling. If we had been able to devote all our time to this branch of our duties progress would have been more rapid; other parts of the manufacturing process have however received attention and a large amount of analytical work arising out of Food and Drug Laws has been demanded by the Associations governing tea interests in Colombo and London. In spite of these handicaps, however, definite progress has been made. Interim reports have appeared in the Annual Reports for 1935, 1936 and 1937 and, prior to departure on leave, it is now my intention to summarise these reports, to state the practical conclusions which have emerged, and to indicate the future lines of work which will be carried on during my absence.

The methods of standardisation described above proved completely successful. Two similar battens were found to give exactly equal amounts of dhool under standardised conditions to a remarkable degree of accuracy. By this time the team system of tasting had been inaugurated, and teams in both London and Colombo were unanimous in their opinion that there was not any difference between teas made from the same lot of well bulked leaf under standardised conditions.

The next step was to compare teas made on an experimental roller under a fixed set of conditions with tea made from similar leaf on a full sized commercial roller. The commercial roller was equipped with an electrical drive and Kilowatt recorder while the battens and table were of the same type, the table on the experimental roller being in fact an exact scale reproduction of the commercial table. In the case of the full sized roller it was not possible to apply weights to the cap since it would have involved handling up to about 600 lbs. The spring on the pressure cap was therefore calibrated and a dial indicator made by Messrs. Marshall, Sons & Co. was used to indicate the spring compression in the weight.

Again, we were completely successful, the dhool out-turns, etc. being exactly comparable and the teas so made were found to be indistinguishable by both teams of tasters.

These experiments proved that our experimental results were applicable in practice and that commercial rolling could be standardised without any great difficulty. The independent drive and Kilowatt recorder are not essential and similar results may be obtained with a calibrated spring provided the speeds of the rollers are equal and constant.

The importance of this finding cannot be over-emphasised since it has been proved conclusively that haphazard methods of rolling may be avoided. A certain amount of experimental work will always be necessary, however, in tea factories if only for the reason that the Tea Research Institute cannot work out details for all the different conditions in all the various tea districts of the Island.

Such experiments can be put on to a definite basis and findings will be of much more value than those of rule of thumb methods Whereas a century of vague and indefinite experimentation has failed to give any marked measure of agreement a decade of logical and organised trial must, if there is any reason at all about tea manufacture, afford specific information on which rolling methods can be based.

The preliminary results with the standardisation of rollers were published in 1935[5] and at the same time[6] the necessity for attention to rolling programmes and the output of the rolling room in relation to firing capacity was pointed out. The time was opportune, for in the past two or three years several devices for standardising roller pressures have appeared on the market and general interest in rolling room organisation has been very marked. Factory organisation has received our fullest attention and support; the subject was discussed at the Conference in 1937 following a paper by Mr. F. J. Whitehead

who has shown much ingenuity in planning programmes applicable to almost all types of manufacture. This paper and discussion appeared in *The Tea Quarterly*;[7] we also obtained an article on the same subject from Mr. G. K. Newton.[8]

Two devices[4] for facilitating the working of rolling room organisation have been tested out in St. Coombs factory, and may be seen by visitors to the factory. We are also prepared to assist anyone wishing to draw up a suitable programme for their factory.

Standardisation and organisation of tea rolling has made remarkable strides in the past two years and neglect in any factory to give these matters the fullest consideration is to be deplored, not only because they enable a definite procedure to be adopted and adhered to (the alternative being haphazard manufacture) but because they are essential to the adoption of ideas resulting from further research on manufacture. Apart from organisation, standardisation of rolling methods in any particular factory cannot be achieved satisfactorily unless rolling methods are defined in terms of time, speed, pressure in pounds weight, batten type, and dhool percentage in relation to a certain mesh size, and it follows that real progress cannot be made until the majority of tea factories are in a position to carry out such methods accurately.

There can be little compromise in this matter and it should be widely realised that research is of little value if methods advocated cannot be practised accurately.

It is not as generally recognised as it should be that terms such as "Hard Pressure" and "Light Pressure," "Dhool Out-turn," etc. mean next to nothing at all unless the pressure is defined in terms of period of application and pounds weight, and dhool out-turn is defined in terms of mesh size (assuming efficient roll breaking and sifting). For instance, a type of batten that cuts rather than twists will give a large percentage of dhool passing through, say, No. 4 mesh with a very light pressure. If the spring on a roller cap is weak it may be fully compressed without giving a very large pressure and in such a case the full spring compression and the high dhool out-turn may give a misleading impression of hard pressure. Results will, however, be very different where a different type of batten that gives a low dhool out-turn even under really hard pressure is employed. To take the extreme opposite case to the above, the roller may have the second type of battens and the spring may be a powerful one; if somewhat inefficient sifting is carried out over No. 6 mesh, the dhool percentage separated may not be any higher than in the first case but there will be an enormous difference in results.

I am not exaggerating when I say that in the past, two such entirely different cases were in danger of being considered together under the same category. It is not surprising therefore that methods considered to be identical have given apparently paradoxical results.

The above postulations are germane to our experiments on batten types. Exhaustive tests have been carried out with three different batten types, all of which are common in Ceylon factories. In previous publications these types have been referred to as X, Y and Z for the simple reason that we wished to avoid premature statements about any well-known batten type. It is still my intention to avoid specific reference to batten types, but type X I shall call a cutting type and type Z a twisting type. My reason for doing this is the big difference in dhool out-turn under rigidly standardised conditions, standardisation including the mesh on the roll breaker and sifter. Figures from page 75 of the annual report for 1936 illustrate this point.

TABLE 1

Date	Batten	% Moisture in Withered leaf	% Out-turn of dhools 1 to 3 Total
3.9.36	X	59·3	46·5
	Z	59·3	27·3
15.9.36	X	56·4	47·7
	Z	56·4	24·9

The cutting type of batten produced almost twice the percentage of dhool that the twisting type produced, and the first conclusion we came to in batten experiments was therefore that there are big differences in the effect of battens. Recently we commenced investigations of a type of batten, very widely used, which is even more severe than type X and the danger inherent in reference to a batten type by name is very well illustrated by the enormous difference in performance when the battens on the door were changed. Aluminium battens on the door were substituted by similarly shaped and sized battens of teak and the result was that the dhool percentage fell as follows:—

	No Pressure	Pressure applied by first set of weights
Before alteration to door battens	21% dhool	29% dhool
After alteration to door battens	8% dhool	16% dhool

The battens still conform to standard types in commercial use and the makers offer both types of door battens, no distinction being drawn in name.

The indications are therefore that battens should be referred to by effect rather than by name since a particular name often covers a range of very different types. Very little in the way of standardisation of batten types has so far been achieved and, even when engineering firms offer a type constructed according to definite plans, several alternatives in detail may be offered and the battens may be further modified when repairs are effected. The first broad division in the classification of battens should be into cutting and twisting types and I shall adhere to this until it becomes necessary to subdivide into further classes of each type.

Having reached this conclusion, it is then necessary to follow up the effect of cutting and twisting battens upon quality. The first experiments along these lines gave rather startling results and I now give the valuation of the B.O.P's taken from the first three dhools described in Table I.

TABLE II

Date	Batten	Valuation (Average) Colombo	London
3.9.36	Cutting type	78 cts.	$15\frac{1}{4}$ pence
	Twisting ,,	80 ,,	17 ,,
15.9.36	Cutting type	78 ,,	$17\frac{1}{2}$,,
	Twisting ,,	87 ,,	$20\frac{1}{2}$,,

Differences of 9 cents and 3 pence in B.O.P.'s justifies the description just given; such differences were indeed startling and we at once began to seek the reason. It was not hard to find since in one case the B.O.P. was taken from only approximately 25 per cent of the total charge, that being the percentage of the first three dhools. while in the other case the B.O.P. came from approximately 48 per cent of the total leaf. Such a large difference is however interesting in that it serves to illustrate the snags encountered in experimental work and as a warning against indiscriminate sampling. When a commercial scale experiment carried out in the course of normal factory practice gives contradictory results, the sampling should be examined carefully since it is obvious that even with

uniform leaf, differences in grade percentages, particularly selling grades, may have a considerable effect upon the average realised by an invoice.

It became necessary therefore to grade out the whole of the roller charges and to send all grades for valuation when making further comparisons between cutting and twisting battens. The question then arose as to how the comparison should be made since, owing to the big difference in dhool out-turn under standard conditions, large differences in grade percentages were inevitable if the same conditions were maintained for both rollers. We eventually decided to carry out the comparison under the following conditions with the hope that some definite pointers would emerge:—

1. Equal pressures and speeds.
2. Equal pressures and speeds to a predetermined big bulk out-turn.
3. Equal dhool out-turn.

The first experiment was particularly difficult to carry out because at the end of three rolls the bulk in the cutting type roller was reduced to 22 per cent and the remaining quantity was insufficient for a further roll.

TABLE III

		Cutting type	Twisting type
Dhool 1	...	14%	7%
2	...	29%	16%
3	...	35%	20%
Bulk	...	22%	57%

The pressures applied gave an already low dhool out-turn with the twisting type of batten and it did not appear as if any advantage would be gained by reducing pressure. The figures again illustrate the large differences which may occur between battens although for practical purposes they are perhaps rather extraordinary. However, we fired and graded out the teas in such a way as to get as much of the selling grades as possible and, in spite of the abnormal dhool out-turns and bulk percentages, the teas were very favourably reported on and the valuations were high as shown in Table IV.

TABLE IV

Per cent Out-turn of Grades and Valuations (Average).

Grade	% Out-turn		Colombo Valuation in cts.		London Valuation in pence	
	Cutting type	Twisting type	Cutting type	Twisting type	Cutting type	Twisting type
B.O.P. ...	66·7	36·7	87	92	$17\frac{3}{4}$	$17\frac{3}{4}$
F.P. ...	6·0	5·3	$85\frac{1}{2}$	91	18	$17\frac{3}{4}$
O.P. ...	3·7	5·6	78	80	$16\frac{1}{8}$	$16\frac{1}{8}$
B.P. ...	11·3	30·7	77	80	$15\frac{3}{8}$	$15\frac{1}{8}$
Pekoe ...	6·3	16·7	86	89	17	$16\frac{3}{4}$
Fannings ...	4·0	3·0	90	91	$17\frac{1}{4}$	$16\frac{7}{8}$
Dust ...	2·0	2·0	74	74	$16\frac{1}{8}$	$15\frac{3}{8}$
"Sale" Average			85	$86\frac{1}{2}$	$17\frac{3}{8}$	$16\frac{5}{8}$

The figures given in Table IV are of course averages for several experiments.

In this case, although the Colombo tasters still preferred the teas from the twisting batten, London did not make any difference in the B.O.P.'s and, on the whole, preferred the teas from the cutting batten. We are now finding that London and Colombo tasters often show a consistent difference of opinion and we shall no doubt have to take market differences into consideration in all our experiments. In both cases samples are tasted blind and the opinions over a series of these experiments are remarkably constant. Differences of opinion are consistent and obviously due to different market requirements. Reference to Table IV indicates that the grade percentages had a very marked effect on the "sale" average and in subsequent experiments these were adjusted to be as nearly equal as possible. The first series of experiments were, as already pointed out, rather abnormal but considered together with subsequent experiments afford some insight into general tendencies. The second series of experiments were designed to bring the total dhool percentages and big bulk out-turn more into line with general practice.

Extra rolls were taken with the twisting type of batten so that the percentages of dhools, bulk and therefore grades were as nearly equal as possible. Under these conditions the B.O.P. and the F.P. represented the greater part of the charge and attention was confined to these two principal grades as shown in Table V.

TABLE V

Grade	Colombo Valuations in cents Cutting type	Colombo Valuations in cents Twisting type	London Valuations in pence Cutting type	London Valuations in pence Twisting type
B.O.P.* ...	77½	80	15⅝	16
F.P.* ...	80	81	15½	15¾

* The B.O.P. and F.P. constituted the greater part of the tea.

We found that both Colombo and London tasters preferred the teas from the twisting type of batten; the valuations on the whole were lower since this series of experiments were carried out several weeks later, the season and markets having changed in the meantime. It is significant that Colombo tasters consistently preferred the teas from the twisting battens in all the experiments up to this point, no doubt on account of their fine appearance. The Colombo market undoubtedly attaches more importance to leaf standards than the London market; this point again emerged when experiments were conducted with the Clivemeare roller.

In the third series of experiments the comparison on a basis of equality in mechanical conditions was abandoned except in the speed of the roller, the pressures being adjusted to give equal individual dhool out-turns. The dhool out-turn to be aimed at in each roll was of course decided before-hand and followed the usual lines of a small dhool from the first roll, followed by increasing amounts taken from the later rolls. In this case very much heavier pressure had to be applied to the twisting batten in every roll compared to the cutting batten.

The grade percentages were again similar and the greater part of the leaf went into B.O.P. and F.P. grades. The valuations are shown in Table VI.

TABLE VI

Grade	Colombo Valuation in cents Cutting type	Colombo Valuation in cents Twisting type	London Valuation in pence Cutting type	London Valuation in pence Twisting type
B.O.P. ...	76	74	16½	16½
F.P. ...	74	72½	16⅜	16⅜

Application of hard pressure to the twisting batten altered results considerably, for in this case its former advantage in the opinion of both Colombo and London tasters disappeared, Colombo

tasters actually preferring the teas from the cutting batten. This result was at once pursued further.

Two identical rollers equipped with the cutting type of batten were available and results from these under conditions of normal and heavy pressure were compared in a further series of experiments. In one case sufficient pressure was applied in a preliminary experiment to give an orthodox series of dhool out-turns which for the sake of clarity I will give in Table VII.

TABLE VII

Dhool 1	...	8%	Dhool 4.	...	20%
2	...	16%	5.	...	20%
3	...	25%	Big Bulk	...	10%

These figures were adopted as a standard and were adhered to throughout the whole series of experiments. The pressure used in this preliminary experiment served throughout in the roller having normal pressure application.

Full pressure was applied throughout in the other roller, and the dhool percentages taken in each roll were adjusted to the figures given in Table VII by the use of a suitable size of mesh in a separate roll-breaker. This of course involved many trials but finally we succeeded in arranging everything according to plan and the series of manufactures were carried out with a high degree of accuracy. As would be expected, the grade percentages obtained from the two lots of leaf rolled under such different conditions varied considerably; all grades were therefore submitted to the tasters for opinion. The average figures for the series are given in Table VIII together with a "Sale" average computed on the basis of the average for an invoice.

TABLE VIII

Grade	% Out-turn		Colombo Valuation in cts.		London Valuation in pence	
	L. Press	H. Press	L. Press	H. Press	L. Press	H. Press
B.O.P. ...	45·2	49·6	76	74	16¾	16⅝
F.P. ...	14·0	2·5	75	72½	16¾	16¼
O.P. ...	5·7	5·5	75	73	15¾	15⅜
B.P. ...	18·6	26·1	72	72	15⅜	15¼
Pekoe ...	8·8	4.0	72½	71	16	15¾
Fannings ...	5·8	9·2	74	72	16⅜	16⅛
Dust ...	1·9	3·1	69	69	15⅛	15⅛
Average :—			74½	73	16⅜	16

Taster's opinion was in this case unanimously in favour of the teas made from leaf which had been rolled under normal pressure as against what we may call "forced pressure."

A further practical conclusion consistent with the results of this whole series of experiments may therefore be drawn and is to the effect that forcing dhool out-turn by the application of heavy pressure is detrimental to quality. The reason for this appears to me to be fairly obvious and is concerned with the circulation of leaf during rolling. Tea rolling in the normal type of roller is essentially a twisting action and this cannot proceed unless the leaf circulates continuously. Application of pressure beyond a certain point, depending on the batten, tends to restrict circulation and will, if sufficient pressure is applied, arrest it altogether. When circulation is arrested, the leaf on the table is dragged round and round the battens and gives rise to greyish tea containing a high percentage of dust and fannings while the leaf in the roller jacket is compressed into cakes which seldom break up completely when the pressure is released. Frequent release of the pressure cap will mitigate this state of affairs to some extent but would not appear to be so effective as a steady lighter pressure which allows continuous circulation. Investigations on this particular point are now proceeding.

With regard to batten type it appears legitimate to conclude that the type I have called the twisting type is preferable to the cutting type under certain conditions. These conditions are well defined and then such a batten is not suitable for obtaining large dhool out-turns. The obvious solution to this difficulty is to use another type of batten when a high dhool out-turn is required, and, as the results I have quoted show, there is not any difficulty in obtaining a type of batten which I have termed the "Cutting" type which will give a high dhool out-turn without the application of pressure sufficient to impede circulation.

In actual commercial practice it is fairly common to find one type of batten used for early rolls and another for reducing big bulk. Experimental justification has therefore been found for this practice and it can be recommended where it is not already in use. A word of warning is however necessary at this juncture; where two different types are already employed it does not necessarily mean that they are the exact types I am referring to and, as I have already pointed out, methods resulting from research cannot benefit general commercial practice unless they are carried out accurately. Batten types are so very diverse that actual trials must be carried out to ascertain the class into which each installation falls; small differences in layout of battens may have a very marked effect upon their characteristics.

I will therefore endeavour to give a definition in terms as general as possible of the battens I have referred to as cutting and twisting types. Using No. 5 mesh in an efficient roll-breaker or sifter, the twisting type I have referred to would give no more than 8 per cent dhool for a 30-minute first roll with the cap just riding on the leaf, the spring being kept under a tension which is just perceptible during the pressure period. Pressure would be applied for eight-minute periods and the cap raised for 2-minute intervals. Under similar conditions the cutting type would give at least 14 per cent dhool and should be severe enough for all practical purposes.

This definition illustrates the difficulties involved in describing rolling methods with any degree of accuracy and I venture the opinion that before long it will be necessary in the interests of rationalism to speak of pressure in pounds weight and to relate it to the size of roller employed.

The results I have just described and the conclusions I have drawn from them merit careful attention when the question of the pressures to be applied in a rolling programme is being considered. When it is desired to improve liquors and increase in pressure is resorted to, great care should be taken to avoid defeat of the object in view by some secondary effect of the pressure increase. If for instance a cutting type of batten is employed the result of increased pressure will be a very large increase in dhool out-turn. A large dhool out-turn in the first two rolls means that a high percentage of the leaf only receives 30 minutes or one hour of treatment, whereas if the dhool out-turn is small a greater percentage of the leaf receives three or four rolls. Further if the high dhool percentage in early rolls is arrived at by short periods of extremely hard pressure on a cutting batten, the period of effective rolling is even shorter. For instance 20 per cent of first dhool may be arrived at by very hard pressure applied for five-minute periods, the interval between pressure periods being 10 minutes. In such a case the hard pressure will almost certainly defeat its own object in that the leaf is actually rolled under pressure for only 10 minutes per roll in which case 20 per cent of the made tea would have received only 10 minutes of rolling under pressure. If this process is described as "Hard rolling" it is surely a misnomer. On the other hand, the same dhool percentage could be arrived at with a twisting batten, employing moderatedly hard pressure for eight-minute periods with two-minute intervals. In this case the 20 per cent of tea arising from the first dhool would have received 24 minutes of rolling under pressure or $2\frac{1}{2}$ times as much as in the first case.

Obviously there are a large number of different combinations of battens, pressures and rolling periods which may be employed;

my object is to draw attention to the lack of definition in rolling programmes and I would suggest that in commercial practice more attention should be paid to batten effect, (*i.e.*, twisting or cutting), pressure in pounds weight, and total pressure period.

In general it may be stated that much more pressure can be applied to a twisting type of batten without excessive dhool out-turn than to a cutting type of batten and that the pressure applied should never be sufficient to stop circulation of leaf.

Provided circulation of leaf in a roller is good, there is seldom excessive heat generation because the circulation of the leaf pumps air through the roller jacket and the leaf is cooled by conduction and evaporation. The dominant factor in heating is actually the state of the wither; a medium soft wither seldom allows much rise in temperature during rolling when circulation is good, while on the other hand a hard wither with a poor circulation will lead to very high temperatures during rolling which do not fall very readily when the cap is raised. Investigations of the effect of heat during rolling are in progress and experiments with cooling processes are being planned (*Cf.* Air conditioning) but it must be borne in mind that the heat may be only symptomatic of other troubles (as it is in animal fevers) and not the real cause of poor results. The old saying that "Heat is the enemy of quality" should not be followed blindly since, for instance, a certain amount of warmth in the leaf is essential for good fermentation and if this is not in the leaf when it is put on to the fermenting table the process may be unduly prolonged.

Before our rolling experiments had been in progress very long it appeared to me that the fundamental problem in rolling with the ordinary type of machine was how best to apply force to accentuate the twisting action. The only method of approach is normally by application of pressure to the cap and this is attended by difficulties with dhool out-turn and circulation. Once dhool of 5 mesh size is separated from the flush it appears to be impossible to get any further twisting action on such small particles.

It appeared to me that the ideal batten, at least for preliminary rolls, was one which would allow considerable pressure to be applied without excessive dhool formation and without restriction of circulation. An examination of the various types available was commenced in order to collect information on this matter; it is hoped that it will eventually be possible to design a batten which will meet these requirements and at the same time prevent throw-out.

The possibilities of alternative mechanical systems of rolling have, however, been carefully considered and in this matter we have been fortunate in making contact with Mr. Clive Meares.

Mr. Meares who has had considerable experience of the tea trade came to Ceylon with a new type of rolling machine and commenced experiments up-country. Shortly afterwards I had the opportunity through the kind services of Mr. Kenneth Morford of seeing these experiments and, as a result, suggested that the work should be continued at the Institute where facilities were more favourable for exploratory work of the nature involved.

At this point I should like to pay a tribute to Mr. Meares who, thinking over the subject of tea manufacture after retirement from the trade, formed definite ideas about the rolling of tea (see *The Tea Quarterly*, Vol. X, Part II), and came out from England at his own expense to test these ideas in practice. Mr. Meares has shown the courage of his convictions and has also been remarkably unbiased about results and I feel that the industry owes him a debt of gratitude whatever the outcome of the new method may be. During the first month of the experiments at St. Coombs we had the great benefit of Mr. Meares' personal assistance and advice and the fundamental principles of the method followed ever since were worked out during that period.

Briefly, the Clivemeare roller consists of two smooth, even speed, rollers which rotate in opposite directions. The gap between the rollers through which withered leaf is passed is adjustable and may be set as fine as 1/1000th of an inch. Leaf passing between the rollers is subjected, momentarily, to an enormous pressure and with full pressure may, in fact, be completely disintegrated. The time is not yet opportune to describe the experiments in full and if the method passes into general use the best way of disseminating information will undoubtedly be practical demonstration at St. Coombs.

The smaller the gap between the rollers, that is to say the higher the pressure employed, the brighter and more coppery are the resulting infusions and the stronger the liquors. As would be expected, however, complete disintegration of the leaf in rolling gives a very unorthodox appearance to the dry leaf and the aim and object of a year's experimentation has been to obtain as much improvement in infusion and liquor as is consistent with passable standards of dry leaf.

The difference between the requirements of the Colombo and London markets has been illustrated very forcibly by reports on teas from this particular series of experiments. The dry leaf standards demanded in Colombo are so severe that there does not at present appear to be much hope of success in that quarter. The blenders who buy on a large scale on the London market have, however,

shown a marked interest in Clivemeare teas and when we had succeeded in reaching a certain standard of appearance it was suggested that we should manufacture an invoice for sale in London.

As a result of many experiments a relatively satisfactory standard of dry leaf appearance has now been attained; the principle of the method being to take a softer wither than normal and to pass the withered leaf straight through the Clivemeare roller. Passage through the Clivemeare roller is followed by treatment with ordinary rollers with the object of imparting the familiar twist to the leaf and working the leaf into a state in which it will dry black. Unless the treatment following Clivemeare rolling is carried out along certain definite lines the leaf tends to dry brown instead of black with the result that it is practically unsaleable. Careful manufacture will, however, produce a tea which is almost indistinguishable from the normal product except to the expert eye. Some misgivings have been expressed about the preservation of Ceylon character and this aspect is receiving our closest attention; on the other hand the opinion has been expressed by equally unbiased authorities that Clivemeare teas have much brighter and more even infusions and that the liquors "have got the better quality that up-country Ceylon should have." An invoice of Clivemeare tea has now been manufactured and sent to London for sale on the open market; an invoice manufactured on alternate days by the normal method serving as a standard for comparison. Working on a commercial scale we succeeded in producing a satisfactory standard of leaf and preliminary reports have been very satisfactory. It may be possible to give further details in an appendix to this article* if the full reports are available before going to press. Meanwhile the grade out-turn may be of interest and was as follows:—

TABLE IX

Clivemeare manufacture			Normal manufacture		
			B.O.P.	...	59·3%
B.O.P.	...	54·2%	F.P.	...	19·8%
Pekoe	...	17·4%	O.P.	...	0·5%
Fannings	...	16·9%	B.P.	...	1·2%
Dust	...	8·2%	Pekoe	...	0·6%
B.M., etc.	...	3·3%	Fannings	...	13·0%
			Dust	...	3·2%
			B.M., etc.	...	2·4%

* Since this article was written these invoices have been sold. The reports received are discussed on page 118.—Ed.

Of the Clivemeare manufacture, B.O.P., Pekoe, Fannings and Dust were sent for sale and of the normal manufacture, B.O.P., F.P. and Fannings only were sufficient for shipment. The number of chests in each invoice was 54. To complete this account of our work with the Clivemeare roller I will quote some further observations made in my annual report for 1937.

"Some very interesting questions from the chemical and biochemical point of view have been raised by the Clivemeare process. One is apt to explain all improvements in rolling as due to 'more thorough expression of juice' which is very vague and is really only a roundabout way of restating the fact that improvements have taken place.

"When hard pressure is applied to leaf with the Clivemeare roller there is a most marked increase in colour and strength when compared with identical leaf manufactured on ordinary rollers. If this improvement were due entirely to a greater disruption of the leaf, it would be reasonable to expect that the liquor would contain a greater weight per cup of total solids in the case of the Clivemeare liquor than in the ordinary liquor. If such were the case, there would be a possible disadvantage in the Clivemeare leaf if the extra colour and strength in the first cup was merely a result of most of the soluble material passing into the brew and so exhausting the leaf that a second brewing would give a very watery liquor. In such a case there would inevitably be complaints from many consumers who want the utmost value for their money.

These considerations were put to the test on seven samples as follows:—

Sample No. 1 was St. Coombs ordinary commercial B.O.P.

,, ,, 2 was a Clivemeare B.O.P., in which the withered leaf was put straight through the Clivemeare machine.

,, ,, 3 was a Clivemeare B.O.P., in which the withered leaf had been rolled once in the ordinary way before putting through the Clivemeare machine.

All these samples were made from the same batch of green leaf.

TABLE X

Sample	% Extract	% Caffeine	% Theotannin Iodine method	% Theotannin Formalin method
No. 1 St. Coombs, B.O.P.	41·0	3·20	21·5	20·5
,, 2 W.L. Clivemeare B.O.P.	38·2	3·08	21·1	20·3
,, 3 R.L. Clivemeare B.O.P.	40·0	3·04	20·6	20·1

"The brew in this case aimed at complete extraction of the leaf, which was boiled for **30** minutes.

Sample No. 4 was again a commercial St. Coombs B.O.P.

,, ,, 5 was a corresponding Clivemeare B.O.P.

,, ,, 6 was a Diyanilakelle* B.O.P., which is well-known for its strong and coloury liquoring characters.

,, ,, 7 was made from longer withered Diyanilakelle leaf by the Clivemeare process at St. Coombs.

"In this case the teas were brewed for 5 minutes using tasters' cups and scales.

TABLE XI

Samples	% Water-soluble matter extracted successively			
	1st brew (5 mts.)	2nd brew (5 mts.)	3rd brew (5 mts.)	Total
St. Coombs B.O.P. (Factory roller)	25.4	7.7	3.1	36.2
St. Coombs B.O.P. (Clivemeare)	26·1	7·3	2·5	35·9
Diyanilakelle B.O.P. (Factory)	26·3	8·6	3·5	38·4
Diyanilakelle B.O.P. (Clivemeare)	27·4	7·1	2·6	37·1

"Perusal of the figures appertaining to these seven samples indicate that the total soluble extract of the Clivemeare leaf is actually less than that of ordinary tea. To a slight extent, the relative amount of solids extracted in the first brew is higher than in the case of ordinary B.O.P. but this was not actually discernible to the eye, the Clivemeare leaf appearing to give the more coloury liquor in each of the three brews. The difference in the first brew was quite remarkable in the case of the short-withered St. Coombs leaf. We cannot, therefore, explain the action of the Clivemeare roller by the relative amount of soluble substance which it renders available for liquoring. The various substances which contribute towards colour and strength and other tea characters must be present in a better form or state although their total weights are of the usual order.

"This is in keeping with Mr. Clive Meare's own explanation which attributes the improvement of liquor and infusion to the short and complete nature of the rolling process which starts fermentation of all liberated substances at the same time. All the "Juice" therefore has the same fermentation both in regard to time and temperature.

* We are indebted to Mr. A. T. Sydney Smith for these facilities.

"The suggestion is, therefore, that the actual mechanism of the improvement is to be sought in the fermentation.

"Determination of the enzyme activity of carefully selected and bulked leaf after treatment in ordinary and Clivemeare rollers reveals a much higher activity in the leaf rolled in the Clivemeare roller. In the earlier experiments the residual potentially active enzyme in the fired tea was found to be twice the normal amount, which was consistent with certain difficulties in keeping quality experienced at this stage of the experiments. The fermentation of Clivemeare rolled leaf is markedly quicker than normal as would be expected from the high enzyme activity, and this appears to be, at least to some extent, responsible for the fine red colour of the infusions."

SUMMARY AND CONCLUSIONS

1. Prior to departure on leave I have collected together the principal results of the rolling experiments carried out during my first tour in Ceylon.

After making myself acquainted with the methods prescribed in Ceylon I came to the conclusion that definition of rolling methods as practised was impossible and devoted my energies to defining and standardising experimental methods.

2. The machinery installed for this purpose proved extremely successful and later experiments showed that results with the experimental equipment were comparable with and applicable to commercial methods.

Full support has been given to means for rationalising rolling including factory organisation in general, and attention is drawn to the fact that results of research cannot be made use of until commercial factories are able to standardise the rolling process.

3. The use of springs calibrated in pounds weight is strongly recommended.

4. A suggestion is advanced that battens should be classified into cutting and twisting types and the following general definition of these types is advanced with the reservation that in future all such definition will have to be made in terms of pounds weight of spring compression.

A. *Twisting type*—with No. 5 mesh in an efficient roll breaker not more than 8 per cent dhool after a 30 minutes' roll with pressure periods 8 minutes on and 2 off.

Cap just resting on leaf with spring under a tension which is just perceptible.

B. *Cutting type.*—A batten which gives more than 14 per cent dhool under the same conditions.

5. The percentages of selling grades obtained after sifting influence the results of rolling experiments to a considerable extent. Attention is drawn to this fact for consideration in commercial experiments carried out on estates.

6. Consistent differences in the requirements of the Colombo and London markets were encountered in the course of rolling experiments. The Colombo market pays particular attention to teas of fine appearance.

7. The application of heavy pressure to force dhool out-turn is undesirable. The explanation advanced is that very heavy pressure impedes circulation of leaf in the jacket and defeats its own object, since the principle of normal tea rolling is the twisting action to which the leaf is subjected and this cannot be provided correctly without circulation of leaf.

8. "Twisting" battens are preferable for early rolls. The "Cutting" type of batten should be used for reducing the bulk of the later rolls.

9. The state of wither is the principal factor involved in the generation of heat in the rollers. Hard withers cause the temperature to rise rapidly.

10. Preliminary results with a new type of roller called the "Clivemeare" roller have been very promising. The machine involves a different principle whereby the leaf is worked into a satisfactory state by direct pressure rather than by twisting. The fermentation of the leaf is initiated much more quickly than in the twisting process and this appears to account for the improvement in liquor and infusion.

REFERENCES

1. Annual Report, 1933, page 58.
2. Annual Report, 1933, page 59.
3. *The Tea Quarterly*, 1937, page 70.
4. This number, page 156.
5. Annual Report, 1935, page 68.
6. Annual Report, 1935, pages 60 and 61.
7. *The Tea Quarterly*, 1937, page 70.
8. *The Tea Quarterly*, 1936, page 199

AIR CONDITIONING IN TEA FACTORIES

J. LAMB

Rightly or wrongly, the idea that high temperatures in withering, rolling and fermenting are inimical to quality, is widely accepted amongst those engaged in the Ceylon Tea Industry. There is also a school of thought in Ceylon which extends this idea in practice by drying at much lower temperatures than the usual 190-200°F.

Since in tropical countries air conditioning is almost invariably associated with cooling, it is not surprising that it is becoming a matter of general interest in Ceylon.

In order to put matters quite clearly it should be pointed out that, strictly speaking, any change in temperature or humidity of the air brought about by artificial means constitutes air conditioning. The present method of tea manufacture is in fact largely dependent on air conditioning since artificial withering, rolling room humidification, and drying in the present form of tea drying machine all involve the conditioning of air. Air conditioning as a means of obtaining cool conditions will therefore only extend methods already in use and not involve radical changes in the principles of tea manufacture.

The purpose of this article is to discuss a more limited aspect of air conditioning confined almost entirely to cooling, and arises from a recent conference held at the Tea Research Institute at which two engineers with specialised knowledge and experience of air conditioning, two planters specially interested in the subject, the Director and the writer were able to discuss the subject from the point of view of the research work which is desirable in this field.

The scope of the article will be limited to generalities and will serve to indicate that this aspect of tea manufacture is receiving attention at St. Coombs.

Cool conditions of manufacture and their effect upon quality of tea have been the basis of two previous articles in *The Tea Quarterly*.

Hall and Dickson[1] put forward some impressive data relating to atmospheric conditions during manufacture and their influence on flavour and described their experiments with "cold withering."

Later Palmer[2] described experiments with the manufacture of low-grown leaf at higher elevations and *vice versâ*, in which the results were decidedly in favour of manufacture at the higher elevation.

A striking case of the apparent effect of cool conditions of manufacture occurred within our own experience through the initiative of Mr. Neville Rolfe who transported sufficient green leaf from the low-country to St. Coombs for manufacture on our experimental machinery. The leaf was carried in an open work basket on the back of a car and an equal amount of St. Coombs leaf was packed into a similar basket which was placed near the open doors of the bulking chamber; both lots of leaf were therefore subject to such conditions for the first five hours. When the low-country leaf arrived at St. Coombs both lots of leaf were spread for withering and thereafter manufactured under strictly comparable conditions.

Tasting opinion was unanimous that the manufacture of the low-country leaf at St. Coombs had produced a tea with up-country character and did not make any marked distinction between the two teas made from the two different batches of leaf. Comparison with teas made in the low-country from the same plucking revealed a marked change in character. This particular experiment has not been repeated but the results were so striking as to be worth mention.

These three cases were the only direct evidence available for discussion at the conference and, whilst appreciating the limitations of each case, we were struck by the fact that a common conclusion was reached by three different methods; as an eminent legal authority once pointed out, the value of circumstantial evidence increases in geometric progression. We agreed, therefore, that there appeared to be justifiable grounds for further discussion and opinion was unanimous to the effect that research into the relatively unexplored regions of low temperature conditions during manufacture was very desirable.

From the point of view of formulating research plans we had therefore to consider the stages of tea manufacture at which to experiment with air conditioning and these are best dealt with separately.

Obviously, withering is the first stage at which investigations are desirable.

The two engineers at the conference at once pointed out the cost which would be involved both in machinery and power for cooling and drying the large volume of air at present used in withering. If, however, a closed system were employed, that is to say,

reconditioning the air after use and recirculating, the scheme would be more feasible economically. A certain amount of fresh air could be admitted from time to time as desired.

Some time ago we built a small withering chamber in St. Coombs factory designed to run on the recirculation principle and to wither sufficient leaf to charge one of our experimental rollers. We found the difficulties with the air conditioning unit, which incidentally was made from an old domestic refrigerator, to be insuperable and subsequent long negotiations with certain air conditioning firms proved unfruitful. As a result of the conference, however, expert assistance with the mechanical problems was offered and very readily accepted.

After further discussion it was decided to obtain estimates for a suitable air conditioning unit to fit the chamber we have already built, in order to test the effects of a wide range or combinations of temperature and humidity conditions upon the withering process.

The next point for discussion was the application of cold air in rolling. Again it was pointed out that a closed system would be the only economic possibility for a commercial sized rolling room. Direct application of cold air into the rollers, and brine cooling of rollers, have already been tried on a commercial scale in Ceylon although we have not had the opportunity of testing these installations at St. Coombs. Bearing in mind that we were primarily interested in the investigation of general conditions we decided to obtain an estimate for another plant which would enable us to vary over a wide range the conditions in a cabinet built round one of our experimental rollers.

It is quite conceivable that a temperature low enough to inhibit entirely the fermentation which normally takes place during rolling would suffice in practice. In such a case fermentation could be controlled to a degree of exactness at present unattainable, and these conditions led us to the final point for discussion, namely fermentation.

A certain amount of heat is essential for the fermentation process and we decided that in the event of the installation for cold rolling becoming available the construction of a small fermentation cabinet in which a range of warm and humid conditions could be produced would not offer any great difficulties.

The engineers very kindly undertook to draw up the specifications for the installation which we had agreed upon and also to make representations to their principals on the subject of the cost of the experimental plant with a view to keeping this down as much as possible.

Those interested in tea manufacture in the low-country may be interested to know that we made tentative plans for tests with low-country leaf with which effects are likely to be the most marked. Such tests would be carried out in the low-country.

The meeting agreed however that technical experience of the plant should be gained at St. Coombs before embarking on more ambitious programmes.

Finally, attention must be drawn to the fact that even if certain low temperature conditions are found to be of marked benefit during certain stages of manufacture it does not follow that it will be *economic* to adopt them in practice and much will remain to be done on the problems involved.

If, however, we obtain complete data relating to low temperature effects, the commercial problems will be more clearly defined and the information will either encourage development of air conditioning or save waste of money on useless commercial installations.

Lastly, I wish to express my thanks to Messrs. H. Carlton, James Wilson, Neville Rolfe, and R. C. P. Adams for attending the conference.

MACHINES AND MATERIALS. A SUMMARY OF TESTS CONDUCTED AT ST. COOMBS FACTORY.

J. LAMB.

During the past two or three years there has been a marked increase in the number of tests which we have been asked to conduct with various new machines and materials introduced into Ceylon. At the present moment this part of our duties is becoming liable to disorganise other research work and it is possible that some reservation will have to be imposed in the near future.

However, in so far as equipment new to the Ceylon Tea Industry is concerned, it appears a legitimate part of our duties to carry out at least initial tests and we shall always endeavour to fulfil this function as far as our Staff, (*i.e.*, Biochemical Department Staff) and other facilities permit.

The Board of Control has laid down certain rules including the reservation of our rights to publish information derived from such tests and a brief summary usually appears in the annual report.

This summary is normally sufficient to indicate the conclusion arrived at and requests for information could sometimes be saved if the annual report were consulted. Where details are required, however, much information is lodged in our files and we are only too pleased to be helpful whenever possible. Very often it will be possible for those interested to see the particular piece of equipment at St. Coombs and for this purpose appointments can be arranged; on the contrary, however, it is exceedingly difficult to maintain organised work when visitors arrive without notice.

The purpose of this article is to draw attention to this branch of our activities and to give a brief indication of our findings; the writer's departure on leave also occasions the drawing together of miscellaneous information, the delay in publication of which may invalidate its usefulness to the Industry.

WITHERING

1. The different types of withering material having a much more open weave than ordinary jute hessian have been tested for effect on rate of wither and quality of resultant teas. In each case a very slight effect on rate of wither was revealed by moisture content determinations, but it was not apparent to the eye or touch. The leaf from the different materials was manufactured separately over a prolonged period but when results were averaged out there was a surprising uniformity in all the valuations. In short we could not detect any difference of commercial importance between any of the withering materials of open weave compared to the ordinary weave of jute hessian.

The open weave construction of jute hessian markedly reduces its wearing properties. Linen cloths of similar construction are stronger, but it is doubtful whether they will outlast the jute hessian cloth of ordinary weight. One of the materials tested which had been treated with Cutch did not give any trouble with taints when new. This suggests that Cutch treatment of ordinary hessian might be advantageous.

2. A locally made cotton cloth proved to be unsuitable for withering.

3. The question of fireproofing hessian was examined and certain materials tested. Processing of this nature could only be carried out effectively by suppliers.

4. *Withered Leaf Sifting.*—Machines made by Messrs. Colombo Commercial Co. and Messrs. Walker & Greig Ltd. have been tested and found to be very satisfactory. No. 4 mesh proved to be the best size for employment in withered leaf sifting. Tip passing through the mesh may be recovered by winnowing.

ROLLING

1. *The Clivemeare Roller.*—References to this machine have been made in previous publications. Experiments have reached the stage of commercial scale experiments and the results have been encouraging.

2. *Fermenting Surfaces.*—Aluminium and galvanized iron have been tested for use in fermenting trays. Aluminium is quite satisfactory. The quality of galvanized iron on the market is so poor that its employment cannot be recommended. Tests with monel metal are being arranged.

3. A rolling pressure indicator of the dial type made by Messrs. Marshall, Son & Co. proved to be quite useful. This instrument gives an easily visible indication of pressure in terms of pounds weight.

FACTORY ORGANISATION

Two ingenious devices for setting out manufacturing programmes so that exact details of the work which should be carried out at any minute of the manufacturing day are clear to all the factory staff, have been tried out. Both devices are adaptable to changes in programme and are very satisfactory.

Anyone entering the factory at any time during working hours is enabled to tell at a glance whether routine is proceeding smoothly. A great deal of record keeping is rendered superfluous by these indicators.

One device is called the "Tell Tale Indicator" and has interchangeable slides for relating the time, while the other is attached to a clock with a single indicator hand along which may be read off details of rollers in use, roll breakers in use, and details of dhools in relation to the exact time within a 12-hour period.

The "Tell Tale Indicator" is adaptable to any programme by the use of coloured pegs and new dials may be fitted to the clock when the programme is changed.

Both these indicators have been devised by Ceylon planters and are available locally.

GRADING

1. *Stamped Aluminium.*—Results with stamped aluminium have been published in *The Tea Quarterly*. The stamping of square perforations in aluminium is a relatively expensive item in production and tests with similar material having circular perforations are now in progress.

2. *Aluminium Scoops or Winnowers.*—Two aluminium winnowers intended to replace the familiar bamboo winnowers have been submitted for test by Messrs. Harrisons & Crosfield. One type is constructed of plain moulded aluminium, and the other, although of similiar construction, has a ribbed or fluted bottom which assists in hand winnowing since it affords the operator more control over the movement of the bulk of the leaf. The fluting affords a gripping surface similar to the weave of the bamboo. Both types are of sound construction and will outlast many bamboo winnowers whilst eliminating contamination of dry leaf by pieces of bamboo.

3. *Sifting Machines.*—A new type of sifting machine called the "Arnott Filtrate Sifter" is now undergoing tests. Messrs. Walker & Greig Ltd. are the agents for the machine.

4. *Surfaces for Picking Over.*—It is generally agreed that black surfaces are the best for showing up red stak. A material called Masonite Presdwood, one type of which is dyed black has proved suitable for surfacing picking over tables. It is supplied in sheets 12 feet × 4 feet, Messrs. Delmege, Forsyth & Co., Ltd. being the agents in Ceylon.

Before use it should be treated with a pink solution of permanganate of potash rendered acid by a few drops of dilute sulphuric acid. Both of these materials are easily obtainable, the latter may be purchased cheaply from garages as accumulator acid. The whole of the surface should be treated with the solution and left for a few minutes. After a thorough washing, tea fluff or waste should be spread on the table and left for several hours. This treatment removed the "new" smell of the material and is useful for many other new materials which are liable to cause taints. Wet tea fluff alone is quite effective for metal or concrete surfaces which must not, of course, be treated with acid solutions.

A black rubber enamel is also being tested as a covering for picking over tables. The material in question is supplied by the Goodyear Tyre and Rubber Co. and is called Pliolite. The material dries quickly and hardens to a satisfactorily durable surface. Preliminary results are favourable.

PACKING

1. *Linings.*—Tests with packing materials have been reported in previous publications. A dozen or more materials including Kraft Paper, Cellophane and various grades of Pliofilm have been tested on a commercial scale.

The scrap value of linings removed from tea chests counts, however, over all other considerations since unfortunately the new materials tested have been at least as expensive as metal foils, and there has not, therefore, been any incentive for tea producers to adopt them even when notably satisfactory as in the case of Kraft Paper.

Tests with lining materials have been discontinued.

2. *Locally Made Momi Chests.*—Locally made momi chests have been found to be quite satisfactory. The samples submitted were in fact superior to the chests made up from imported materials which at the present moment are liable to have an excessive number of knots which became detached from the planks thus forming large holes. It is to be hoped that knot-free timber will be available to the local manufacturers in sufficient quantities to enable them to maintain this superiority. Tests with locally manufactured plywood are also being arranged.

3. *Tares.*—The Ceylon Estates Proprietary Association asked us to suggest a suitable form of tare for tea chests. With the kind co-operation of Mr. James Forbes (Jnr.) and the Colombo Commercial Co., Ltd., we devised and tested tares made from strip iron weighing approximately $\frac{1}{2}$ oz. per inch. Suitable lengths may be cut off with a cold chisel and holes for fixing either punched or drilled.

The tares may then be fixed to the lids of the chests by short nails, long enough to allow of their being clauted over on the outside of the lid.

The tares may be wrapped in cheap paper, although this is not strictly necessary, and should be fixed as close to the batten as possible.

Tares of this type may be made on the estate or obtained from the local firms in mixed lots.

Favourable reports have been received from London on a shipment by this means.

MISCELLANEOUS

Tests with spark arrestors are being conducted in co-operation with the Ceylon Fire Insurance Association.

A NOTE ON THE PACKING OF FORWARD SAMPLES OF TEA

J. LAMB

The despatch of forward tea samples to London has raised many problems with regard to packing. Quite recently complaints appeared in the Ceylon Press of tainting of such samples due to the disinfection of mail bags. However much care is taken by the postal authorities, samples are still liable to pick up taints if the packages are not completely taintproof, and it is quite obvious that the only reasonable line of action in this matter is to use such packages.

Special tins similar to those in which cigarettes are packed for sale in tropical countries have proved satisfactory, but they have several disadvantages. They are not so easily available as ordinary sample tins and they require careful soldering by a fairly expert manipulator; otherwise there is danger of taints arising during soldering through passage of fumes into the tin and of excessive heating of the contents due to clumsiness or carelessness.

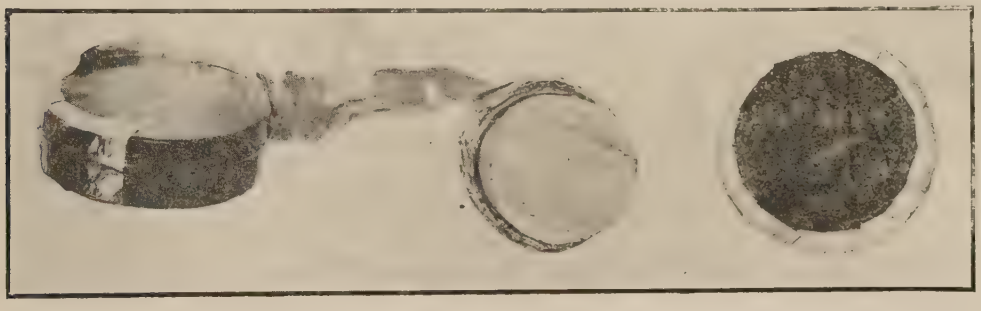

Fig. 1

An adhesive aluminium tape, known as Aglum Tape, which has recently appeared on the market in Ceylon enables completely taintproof packages to be made from ordinary sample tins of any size and can be affixed in a few seconds without any special preparation. The tape, which is sold in rolls like sticking plaster, is smoothed on to the perimeter of the firmly closed sample tin, and an overlap of a quarter-of-an-inch or so is allowed to complete the seal. As the tape is usually supplied in a width of $1\frac{1}{4}$ inches it allows of an overlap of about $\frac{1}{4}$ inch on the top and bottom of a one-ounce sample tin which affords an additional safeguard. (See Fig. 1).

Sample tins sealed in this manner have preserved their contents in a fresh condition when enclosed in a space with crude disinfectant or with sliced garlic and onions for a period of one month. Reports received from London on this method of packing have been favourable and the Institute proposes sending future experimental teas in such packages.

When new sample tins are to be used it is advisable to fill them with waste tea and leave them a day or so before filling with a sample. This device removes "tinny" taints which are liable to occur in samples packed in brand new tins.

The adhesive tape described in this note may be obtained from Messrs. Mackwoods Ltd., Colombo.

SEED SUPPLY IN RELATION TO SUPPLYING AND REPLANTING*

F. R. TUBBS

In agreeing to your Chairman's request for a talk on Replanting and Selection, it appeared to me that the members of the Sabaragamuwa Planters' Association would be particularly interested in the matter of the type of material available for use, for not only are you seed producers, but you are also large consumers of seed. Practically all tea plants are grown from seed, though as I shall mention later, this is not the only method. It behoves us, therefore, to consider the implications involved in the use of seed, and the sources from which the seed is derived.

Variations of two sorts occur between different tea bushes — those due to differences in environment and those due to differences in the inherited character and reaction of the bush to its environment.

In the first class fall all those differences due to external causes such as differences in the fertility of the soil, in its widest sense, and differences in elevation, aspect, shade and so on. You are all well aware that very large differences in the yield and the quality

* Substance of a lecture delivered at Ratnapura to the Sabaragamuwa Planters' Association on July 29, 1938.

of made tea result from differences in fertility of the soil and in the factors associated with elevation respectively. Moreover, not only do these differences occur in the quantity and quality of the crop, but even the very appearance of the leaves on the bush may be altered. Add to such effects as these the fact that the appearance of the bush alters with the length of time that has elapsed since the last pruning, and one might almost marvel that we can recognise the tea bush as such.

Nevertheless, we know that there are certain fundamental combinations of general characters which enable us to distinguish a tea plant from other plants of somewhat similar appearance, and it is upon those combinations that the systems of taxonomic botany were built up. But this constancy of general characters is not found when minuter characters are examined. Just as we are distinguishable from monkeys, but recognisable as individuals, so individual seedling tea bushes, though recognisable as tea and grown under the same conditions, will be found to differ. We thus recognise the existence of differences in character due, not only to varying environments from plant to plant, but also to varying *inherited* constitution between individual plants of tea.

To continue the analogy with human beings, it may be pointed out that geographic races — ill-defined, it is admitted, but still recognisable, occur within the species, just as in human beings. Complication, which in Ceylon has reached an appalling complexity, is due to the fact that the races, differing within themselves, have been allowed to cross until our tea fields represent a sort of minced and reblended league of nations. To add to one's bewilderment, records of the origin of the parents of bushes are almost completely lacking, judging from the almost complete silence which greeted the Institute's repeated request for information on the history and character of existing Ceylon jâts.

It would take too long to attempt to convert anyone now who believes that what was good enough will be good enough. But those of you who wish to improve upon the present situation will realise that it is a matter of urgency that preliminary steps be taken in regard to the sources of seed within the Island.

When we consider the matter, we realise that in the course of the many years that tea has grown in Ceylon no variety has been produced which is recognisable as such. Which of you could name with certainty or even reasonable probability the various so-called "jâts" present in a mixture of seedlings or mature bushes from different sources? Such a situation speaks for itself.

To my mind, the course of improvement should lie along the lines:—

(a) Improving the uniformity of existing bearers;

(b) Starting roughly improved bearer areas;

(c) Replacing these with areas of better and more uniform types as they are produced.

You will note that I do not envisage any finality to tea selection, for I do not believe there will be any in our lifetimes. The race will go to him who keeps on going and who goes fastest, although we must not forget to render a libation to luck — the prime arbiter of selection work.

The partial selection of existing bearers can be done by eye, with a view to eliminating those types which depart markedly from the type it is desired to produce under that jât name. I have heard it suggested that the elimination of 2 per cent or 5 per cent will be sufficient to greatly increase uniformity. Well, I have yet to see bearers which I would agree could be improved as they should be so easily — 20 per cent to 30 per cent would often be nearer the mark.

Such elimination would *not* be regular, but it would increase the average spacing of the bearers, which in Ceylon is often far too close. Bearers should on the average have not less than 100 square feet of soil surface per tree, and with a vigorous jât on good soil, this may well be increased.

When eye selection, and where necessary, additional spacing has been carried out, the second method of testing existing bearers may be applied, namely the progeny test. By this is denoted the comparison of the bearers by a rough test of the character of their progeny. In a self-fertilised plant this test would be of great value, but in tea, which is mainly cross-fertilised, the results will not be so plain. Since, however, we are interested in bearers only from the point of view of the character of their progeny, it is a test well worth applying. It is suggested that, when the bearers have been properly spaced, a small nursery bed is made up in the immediate vicinity of each bearer and a definite number — say 100 — of seeds picked from each bearer planted in the bed adjacent to it. After six months those bearers whose seed have shown markedly bad germination should be eliminated, as the bearer may be partly responsible for complete or partial infertility of its seed. After a year, those bearers giving a large percentage of bad type seedlings, or very variable seedlings, should be removed. A further and final selection may be carried out when the seedlings are about 2 years old.

By this method, the improvement at first effected by eye selection of the bearers will be extended and rendered more marked during the subsequent two to three years, and the final product will be about as good as it is possible to obtain by selection among existing bearers. It will be noted that this method not only provides a partial test of the character of each bearer, but it obviates labelling, etc. All cultivation and manure applied to the beds will benefit both the bearers and the stumps and thus the money is likely to give a direct return in addition.

The difficulty of cross-pollination may be roughly surmounted by eliminating those bearers which throw a large proportion of poorer type seedlings, but not those showing relatively very few.

Having achieved, as far as is possible with existing bearers, the desired increase in uniformity, the question of seed-bearer treatment arises. It was, I believe, on the last occasion I visited this Planters' Association that I was questioned upon the subject of seed-bearer treatment, and so I take this opportunity of dealing with the subject.

Pruning should not be indulged in more than is necessary to space branches and admit a sufficiency of light to ripening fruit. Bearers which persist in running up into "beanpoles" are best cut out, for it is likely that they may be deficient in that character of free branching which is the basis of plucking. Even in high Indian jâts which are relatively even I have noted very marked differences in the "bushiness" of young seed-bearers. If an early yield of seed from young seed-bearers is desired, pruning to produce several leaders may be omitted and the tree allowed to spread from a central stem. The Institute is sometimes consulted on the subject of pruning seed-bearers with a view to increasing vigour or to remedy die-back in the upper portions of the bearers. I am inclined to think that in the majority of cases the condition is due, not to any need for pruning, but to the persistent policy of starvation that some seed-bearer areas appear to have sometimes been subjected to in the fallacious belief that their cropping value was permanently in inverse ratio to their vegetative growth.

The size of the seed, and possibly the number set, will be considerably influenced by the amount of leaf in the immediate vicinity of the individual fruit. What is required are well-spaced flowers, not in superabundance, with a generous amount of leaf to manufacture the store of foodstuffs in the developing cotyledons, which will provide the nourishment of the germinating seedling. Also, it must be remembered that the seed is rich in nitrogen, phosphorus, and potash. To help the Institute in dealing with this

matter, I would here make a request for two sorts of aid. Firstly, freshly fallen seed from bearers that have been heavily manured for several years past, and from bearers that have been little, if at all, manured is required for analysis. Dr. Eden and I will be very grateful for anything you can do to help us in this matter. Secondly, what yields of seed are obtained from seed-bearers at different elevations and in different districts in Ceylon? India appear to obtain between 400 and 800 lbs. per acre, but I have heard of figures higher than this. Information is sought upon this subject and will be gratefully acknowledged.

At the present time, about 80 lbs. of nitrogen, 64 lbs. of phosphoric acid and 40 lbs. of potash are suggested per acre of seed-bearers and in some cases even more may be temporarily desirable. The ratio of 10:8:5 has no magic value, but is at least nearer the mark than some I have seen. In passing, it may be noted that there is no more need for complicated mixtures for seed-bearers than there is in the case of bearing tea. With regard to time of application, there is evidence from other crops that an application just before flower opening may assist the set of fruit. It is, therefore, suggested that the manure be applied in 2 or 3 equal doses during the year, one to be applied with a very shallow forking one month before the period of maximum flower opening. The remainder of the manure will then be applied 6, or 4 and 8 months after, with one normal forking.

The question of grading the size of seed has received little attention in Ceylon — possibly owing to a desire to get as many seeds as possible for one's money. But graded seed has many advantages — large seed may be used for seed-at-stake, for instance, and the smaller for nurseries. And the possibility must not be lost sight of (it is under investigation) that in our present mixed seed-bearers, low jat types may occur more frequently in small seed than in large, owing to the tendency of such types to produce a smaller seed. That, however, has yet to be proved. The Institute is at present making enquiries as to suitable grading meshes, and when they are found, the information will be available to those who desire it.

The following calculation is a very rough one, but is given for the benefit of those of you who are attracted by manifest advantages of having sufficient seed-bearers of their own to provide partly or wholly their needs for supplying.

On a basis of 2 per cent supplying, *i.e.*, replacement once in 50 years which under low-country conditions is to say the least of it, conservative, when the bush number is 3,500, an average of 70

vacancies will occur per annum. Having one's own seed-bearers permits of cheap and easy *selection* of the seedlings and, assuming that only the 50 per cent best seedlings are used, and that supplying is 50 per cent permanently successful, 280 seeds per acre per annum will be required. In the absence of exact data about the yield of seed-bearers in Ceylon, the suggested yield of 500 seeds per annum per bearer must be taken with caution, but if this is accepted for well-spaced and well-manured large bearers, it means that at least one bearer for every two acres of bearing tea is required. Giving each bearer 100 square feet, this means that 1/870th of the acreage would be thus utilised — surely not an excessive proportion.

If replanting becomes a major issue in Ceylon, those who possess their own bearers will, I think, congratulate themselves, for they will at least have sufficient seed to maintain their supplying programme cheaply and efficiently, whatever the price of seed should rise to. And if no greater demand for seed does eventuate and things remain as they are, I would still, were I the fortunate owner of an estate, spend a great deal of time and trouble in seeing that I had as the source of seed my own bearers — and no haphazard ones at that, but ones carefully selected at the present stage for uniformity and for yield, and, if possible, later for the quality of their manufactured product.

I may mention here that the latter test — for quality — is likely to be materially assisted by methods of vegetative propagation of individual bushes which have been worked out and are suitable for small-scale work. The possibility of planting of larger areas with clones propagated by cuttings or by seedling grafts is, however, at present still a dream of the future.

I know this question of the quality of the manufactured product will be in your minds, and I will not say more now of selection than that a provisional circular is being prepared which will be sent to those who, knowing that such a task will require a great deal of work, are still keenly interested. If after perusal, they are still ready to tackle the job, then we will provide all the help and advice the limitations of time and small staff permit of. Instead I will now outline my views, I claim no more for them, upon quality and yield as regards selection.

I definitely envisage no standing still on selection once the work is started and when I say "select for uniformity and yield" it is but the first step on attempting to combine yield and a good character of made tea. Yield without quality and quality without yield are likely to be equally useless to us. Methods feasible for selection for yield have, owing to their relative simplicity, been worked out in detail

in forms suitable for estate use. Methods of selection on the basis of the character of the made tea have been investigated by Mr. Lamb, whose part in this and in the analysis of made tea characters published in the last bulletin, I desire fully to acknowledge. These methods are as yet preliminary in nature and will probably remain of laboratory character. So I consider our best policy is to get on with selection for uniformity and yield, and to take the first opportunity of planting out the progeny of selected bearers in areas large enough to permit of ordinary manufacture. Meanwhile the Institute will do what it can to propagate and test any high yielding clonal material given to it. But I may here give the warning that the Institute considers it useless for it to offer to test seedling progeny on a small scale — by the time the bushes were in bearing, the bearers would probably have been reselected and all the work and time would be wasted.

The part of the scientist in so vast a field as this is, in my opinion, to aid and guide the processes of selection which estates can carry out, while elaborating and testing methods and applying those methods of critical investigation, where feasible, that are impracticable on estates. In other words, progress depends neither on Industry or Research alone, but on that happy co-operation of the two, which has so far and will, I believe, in the future, mark this question of selection in Ceylon.

SOME ASPECTS OF TEA SELECTION*

F. R. TUBBS

My presence here today at your Chairman's request follows upon the discussion at your last meeting, in which certain aspects of tea selection were mentioned, which I now wish to discuss briefly in the hope that some of the points which arise when selection is considered may be cleared up.

A moment's consideration will impress upon you the complexity of the problem which the tea industry is faced with when it embarks upon the long-overdue task of securing an improvement in the uniformity and yield of different strains of tea and in the potential "quality" of the produce.

In the field of nursery selection, that is the selection of only the best seedlings for planting out, we can only proceed as far as improving the uniformity and vigour of the new plants. None will deny the advantages resulting from uniformity among the bushes

*Substance of a lecture delivered to the Kotmale-Dolosbage Planters' Association on September 14, 1938.

in a field but it is at present very rare to find anything approaching real uniformity. I am frequently told that a given field is of a "fairly uniform medium jât." Unfortunately in that phrase only the word "uniform" has any definite meaning — and that a meaning which is considerably modified by the other words. If you will take the trouble to examine a representative leaf from each of, say, twenty bushes from one of your "uniform" fields, you will find differences that surprise you — we have all grown so accustomed to regarding *fields* of "tea" as the unit whose character, yield, and reactions to varying conditions have to be studied that it is only by deliberate examination that we become aware of the great differences that occur within single jâts. These differences are more obvious at some periods than at others. A tipping field often appears very uniform relative to older fields and one also gathers a very rosy conception of its "jât." Rich soil produces a similar effect. Again differences between seedlings are less obvious in a young nursery and become markedly more pronounced in the second year; until they are only too glaring during the third year. It is for that reason that nursery selection is most easily performed on stumps two years of age or older, just before they are planted out in the field.

How is this process best carried out? To understand the procedure it is necessary to bear in mind that variations in the appearance and "vigour" of two plants are the product of two separate groups of causes of which the first may be briefly described as differences in the inherited character of the plants and the second as differences in the local environment of the plants. In the examination of a single pair of plants, to take a simple case, if you are unaware whether the conditions of growth were similar, it is not possible to say with any degree of certainty that the observed differences in size is due to the greater vigour of one of the plants, or to the fortunate chance of having, for example, better soil to grow in. If, however, you know both plants come from the same nursery, your judgment is aided, while if you know they were growing side by side the probability that the difference is due to differences in the inherited vigour of the plants and not to differences in environment becomes much greater. This is due to the general law that on the average, chance variations of environment within small areas are smaller than are likely within large areas. Thus it becomes necessary to compare seedlings from relatively small areas only, if we are to pick out with reasonable certainty those plants inherently possessing greater vigour than the normal.

A moment's reflection will show that the nursery as a whole is too large a unit, for whole beds are frequently of obviously poorer soil, for example, than the remainder. Many of you will have

seen cases where half a bed is producing large plants, while the plants in the other half are relatively poor and weedy. This indicates that environmental conditions within a bed are not necessarily even relatively uniform; especially is this the case where raised beds are in use, in which the border plants almost invariably grow under less favourable conditions than the plants in the interior of the bed.

Thus, if we are to ensure that local differences in environment do not vitiate our search for inherently vigorous plants, it is necessary to follow some such procedure as the following: The whole of the plants in the bed should be lifted together *after removal of "off" type plants*, none being left to grow on in the nursery. In the process of lifting, all border plants should be placed in one heap, and the plants from, say, the two halves of the interior portion remaining placed in two other heaps. From these two heaps, a given proportion of the biggest plants are picked out. If $\frac{1}{3}$ of the plants are to be taken, $\frac{1}{3}$ of *each* heap will be selected. Thus some of the discarded plants in the heaps derived from the centre of the bed may actually be larger than some of those selected from the border plants. The reason for this will be obvious in the light of the foregoing explanations. The discarded plants may be used for tea-hedging, a work which, although growing in popularity, still has far too little attention paid to it.

By following a procedure such as this, increased uniformity and increased yield may be obtained. Selecting the 20 per cent best plants has been found to be accompanied by increases in yield of 10 per cent to 35 per cent over the yields given by average plants in Java. Naturally, even larger differences occur between the yields of the best and the poorest — in one case the ratio of yields was 1.73 to 1. If such results are obtained with relatively even jâts, results as large or larger are likely to result from the application of such methods to our mixed seedlings.

Selection among young plants is best carried out in stump nurseries, as has been said, but it is possible to apply some form of selection at almost any stage of planting. Perhaps the most difficult material is basket plants, where only a rough selection for type can be carried out. In the case of seed-at-stake, the policy adopted on St. Coombs is to use the largest seed with a view to getting as good establishment as possible, and to use four seeds per hole. I have here one of the boards used for planting in this way, in the form to which it was modified for estate use by Mr. Rogers. Four seeds a hole were *not* used in order to be sure of each hole having a plant growing in it, but to ensure that in general there would be *more than one* plant in each hole. The area will be thinned to two

plants a hole, leaving the best, as late as possible, and the final thinning to one per hole will also be left until crowding becomes really serious, for the longer the plants are left in the better chance selection has to play its part. Even if a certain amount of check to the growth of the remaining plant is caused by this, of what importance is that, lasting perhaps a couple of months, in a life-history of fifty years, provided that good results?

Another point which was mentioned at your last meeting concerned the advisability or not of using the "big bush" on the estate as a source of seed-bearers. These big bushes are originally chosen because they are larger than the average, but as they may owe this to the absence of competition from neighbouring bushes due to the occurrence of vacancies, it is not safe to assume that they are *necessarily* better than average bushes, for any bush will grow above normal size if freed from competition. For example, out of 193 bushes chosen as the largest in one section of tea, 137 were found to have a vacancy adjacent. In another field 121 out of 140 had vacancies or were edge bushes. Subsequent to the decision to develop the chosen bush, it receives all sorts of special treatment. Neighbouring bushes are cut back or removed, the soil around it is often built up, and last but not least extra manuring and a high pruning level combined with meticulous plucking produce a plucking table of quite abnormal area and density. When we see the bush in the later stages of development, we are liable to forget all the special treatment it has received, but if its use for seed purposes is envisaged it is necessary to adopt a far more critical attitude, for we are only interested in how it would grow under normal conditions. It is, therefore, necessary to propagate the bush and to examine its behaviour under normal circumstances. Two tests may be applied — either it may be propagated vegetatively and an area planted with the clone so formed, or any seed that forms upon its side branches at the end of the cycle may be collected and the character and vigour of the progeny examined. The drawback to the latter procedure is that the male parent is unknown, since tea is largely cross-fertilised. If we do not wish to go to this trouble, then all we can say is that it is not a bad bush, but it is quite uncertain whether under normal conditions it would be sufficiently good to render it worthy of remark or special propagation. In any case, at this stage of tea selection it would be definitely unwise to confine oneself to a seed-bearer area produced by the vegetative propagation of only one bush, however good a yielder it is.

I do not wish to give the impression that I do not think bushes which grow larger than the average, while under normal conditions of soil and competition from surrounding bushes, are not worthy of special examination. Dr. Eden has shown that, on the average,

the crop yielded bears a very close relationship with the amount of material removed at the subsequent pruning. The amount of prunings varies in fair agreement with the visual impression of "size" of the bush and this fact was, therefore, used to provide a means of picking out the more vigorous bushes in a field. It is obviously impossible for a superintendent to scrutinise carefully, and to compare and re-compare every bush in a large field containing perhaps 50,000 bushes. But if when the field is due for pruning each pruner is instructed to leave the two biggest bushes in every hundred pruned which have no vacancy adjacent, the manageable number of a thousand bushes, which include most of the large bushes in the field, is obtained. Moreover, the bushes stand out to the eye, and as soon as prunings are lined, can be easily approached. However, you are unlikely to want to examine in *great* detail a thousand bushes in one field and in any case it is desirable to check over the pruner's choices. The thousand may, therefore, be reduced with advantage to five hundred by a relatively casual picking out of the best of them. After that selection should continue becoming more and more detailed, until the number to be finally examined for yield is obtained. To illustrate this we may take an actual example, in which difficulties were found to arise, as is usual in such work as this.

In one field at St. Coombs I carried out this process in three different sections. In one section of about 20,000 bushes, approximately 400 large bushes were left by the pruners, which by careful eye inspection were then reduced to the best 150 bushes, examined in addition to ensure that they did not owe their extra large size to the effect of neighbouring vacancies, spoil earth, or any other of the more obvious external causes of bush heterogeneity. From this section of the field it was intended to select fifty bushes for yield recording; and the opportunity was taken to see whether the same bushes would be selected if the fifty bushes giving the largest weight of prunings when cut-across 9 inches above the last pruning level were chosen instead of the fifty bushes having the largest diameter at this level. In brief, the answer was "no," and these tables indicate what was found to be occurring.

It is obvious that there is no exact proportionality between pruning weight and either the diameter or the function of the area of the bush at that level, when only the largest bushes in a field are considered and when the cutting-across is done as high up as 9 inches above the previous pruning level. A little thought will provide the reason for this, for although large bushes give more prunings than small ones, within a size class questions of the *habit* of individual bushes arise and affect the weight of prunings when the bush is cut-across at so high a level. Some bushes, for example, when plucked

AREA OF PRUNED SURFACE x 0·733 IN SQUARE FEET.

WET WEIGHT OF THE PRUNINGS IN LBS.	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
3										1																							
4		3	0	1	1	4	1	2	0	0	1	0	1																			
5				4	1	3	2	1	5	2	1	2	2	0	1	0	0	1														
6					4	4	5	1	2	0	1	4	1	1	1	1	1															
7			1	3	0	0	3	2	3	4	2	0	1																			
8					3	1	2	1	2	0	1	1	1																			
9		1	1	0	1	1	2	6	1	1	1	0	1	0	0	1	0	1														
10							4	4	0	0	0	1	0	0	0	0	1	0	1	0	0	1										
11					1	1	1	0	0	1																						
12							1	1	0	1	0	0	0	1	1																	
13									1																							
14										1	0	1	0	0	0	0	1															
15										1	1	0	0	0	1	0	0	1	0	0	0	1										
16										2																						
17																1																
18																																
19																																
20																																
21																																

DIAMETER OF PRUNED SURFACE IN FIVE-INCH UNITS.

WET WEIGHT OF THE PRUNINGS IN LBS.	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3														
4						1								
5		2	1	5	2	2	2							
6				7	3	7	4	2	1	0	0	0	0	1
7				5	9	2	5	3	2					
8			2	2	5	7	2	1						
9				4	3	2	2	1						
10			2	1	6	5	1	2	1					
11					7	1	1	0	2	0	1			
12				2	1	1								
13					1	2	0	2						
14						1								
15						1	1	0	1					
16						1	1	2	0	1				
17						2								
18									1					
19														
20														
21														1

adopt an upright type of forced sympodial growth and so spread very little; these, for their area, will give a large weight of material above the pruning level. Others spread very quickly after pruning and each tipping shoot becomes the origin of a densely branched system, and thus the bush does not become nearly as tall as the other type during the cycle. We are thus forced to return to the visual impression of "size" which, with care and attention, can be made sufficiently accurate for our purposes. It is, therefore, no longer proposed to use the pruning weights after high cutting-across as a selection measure, unless later some advantage of the system is discovered when yields are available from the bushes under examination. The data here discussed, it may be noted, in no way conflict with Dr. Eden's conclusions previously alluded to.

This question of habit is of considerable importance in selection work. I have several times pointed out that pruning is a definite evil; to talk of reinvigorating tea periodically by pruning is fallacious. Pruning is necessary under conditions, firstly to keep the bushes sufficiently low to permit of efficient plucking and secondly to cause the bush in conjunction with plucking to yield with relatively uniformity instead of producing a couple of major flushes a year. The need for the former function of pruning is considerably delayed by a reasonable system of breaking back and more attention might well be paid to this in connection with the extension of pruning cycles, but the habit of the bush is of major importance. Thus we must not lose sight of the fact that desirable bushes in other directions, which have a bad habit of growth and in which the plucking table rises relatively quickly, should not be selected.

A further very important point is to select for bushes which yield well at the *end* of the cycle. In a "run out" field which is "shut up" except for seasonal flushes, individual bushes may often be picked out which are yielding quite well — and they are worthy of special attention.

One of your members remarked, I believe, at your last meeting that the Institute's publications went as far as was possible in the present state of our knowledge of tea selection in Ceylon. This was roughly true, and I have done no more today than to allude to some of the problems arising in selection work. But in conclusion, I may mention that a provisional memorandum on selection of seed-bearers is available to those who are genuinely interested in tea selection — provisional because both Industry and Institute must feel their way together on this matter. We cannot stand still, but a mad rush in any direction will do more harm than good. Only if the most careful and *critical* individual attention is given can selection be looked to for the prizes which we may expect from it.

MOTHER EARTH*

(REVIEW)

The establishment of government agricultural departments and of specialised research stations devoted to single crops in tropical territories has greatly stimulated interest in the scientific aspects of husbandry. But at the same time the problem of how best to interpret the results from these research institutions, so as to make them intelligible to the layman, has become increasingly pressing. However marked the enthusiasm of the layman; however successful the popular exposition of the research worker; there still remains the necessity for each to speak a common language. The one must develop a wholesome agricultural consciousness: the other must familiarise himself with the facts and methods and terminology of agricultural research.

In the realm of soil studies there is a grave lack of books that can be put into the hands of readers to whom even the rudiments of scientific jargon are unintelligible. There are excellent and stimulating books for the student not far removed from the class room: what is required is a book in which the elementary principles of soil behaviour are simply stated in no more detail than is necessary to provide a suitable measure of coherence, and which will throw adequate light on practical illustrations in the realm of cultivation, drainage, manuring, green manuring and the like. The memory of most people is visual, and, apart from some concrete embodiment of a principle, the import and applications of that principle are difficult of appreciation by those untrained to scientific and abstract thinking.

Such a book would be no mere practical manual: it would or should emphasize the æsthetic satisfaction that derives from elegant scientific discovery and theory, which philosophers such as the late J. W. N. Sullivan insist is one of the main fulfilments of those devoted to scientific pursuits. Professor G. W. Robinson's little book is a foretaste of what might be done in this sphere, and, brief and informal as it is, it will shed light in quite a number of dark corners. The plan of the book is novel, being in the form of letters to a friend (Professor R. G. Stapledon). It avoids the text book manner and overcomes the inhibitions against serious reading that reach their maximum after dinner; but it is nevertheless a serious

* *Mother Earth*, by G. W. Robinson, T. Murby & Co., London. 5/6.

contribution to a serious subject written with a charm of style that is rare amongst scientists (a name that Professor Robinson abhors). The letters are titled, and from a survey of some of these the scope of the volume can be judged. After discussing the difference between 'soil' in a general way and 'a soil,' the letters deal with soil material, humus, structure and tilth, soil moisture, soil fertility, manures and fertilizers, lime, etc., besides giving an insight into methods of making and interpreting soil surveys.

Every now and then there is a direct reference to aspects of soil specially relevant to tropical conditions. Amongst these is the following reference to soil erosion and the need for conservation.

> "The luxuriance of tropical vegetation can convey an entirely wrong idea of the agricultural potentialities of the soil on which it grows. It must be remembered that, under virgin conditions, plant nutrients form a kind of closed cycle, because practically all plant food taken from the soil is returned in the form of plant residues. Immediately this closed cycle is broken and crops are taken from the land, the need for replacement arises. Even more serious than the manurial position is the problem of loss of structure, erosion, and soil destruction. And, therefore, when tropical soils are brought into cultivation, soil conservation should always take precedence over soil exploitation." (page 190).

On an earlier page (42) there is a remark which calls in question a very prevalent idea in Ceylon, that of the necessary poverty of our grassland patna soils in comparison with those formerly covered with jungle. Professor Robinson points out that the grassland soils are richer in organic matter under comparable conditions than are forest soils, probably owing to the heavy wastage of leaf-fall immediately after clearing. In Ceylon the dry patnas are poor soils, because of low rainfall and stunted growth of the grass, but Joachim's examination of typical soil profiles (Studies on Ceylon Soils, *Tropical Agriculturist*, LXXXIV 323, LXXXV 21,) shows that wet patna may easily surpass in organic matter forest soils on the border line between wet and dry zones. Of special interest to tea producers are the author's views on quality in agricultural produce "I am not entirely displeased to think that modern science, although it may effect some levelling up, is likely to have little influence on quality in its higher manifestations." The dictum that "It would seem that the presence of a certain amount of fresh organic matter helps to give a good structure" (to the soil) gives quite a topical flavour to his account of the part that humus and unhumified material plays in the maintenance of tilth.

At the beginning of the book Professor Robinson explains that he prefers to be thought of as a natural philosopher and that the

philosophical stand point interests him more than the severely practical. "I am attracted rather to the contemplative than to the active life, although I know that the good life requires a due balance of both" is how he puts it. The treatment given to both aspects of soil is well balanced in his book, but perhaps it is this avowed contemplative inclination that makes Professor Robinson rather sceptical of and impatient with the work of those whose energies are devoted to more or less empirical investigation. After stressing with good reason the necessity of studying soil for its own sake, and claiming that if in any branch of science investigation had been exclusively of an 'applied' nature, both science and practice would have been impoverished, he delivers himself in this fashion.

> "The master-problem of crop production is that of the contract between soil and plant. If the nature of this contract is once understood, the solution of problems of crop growth follows naturally. This problem will not be solved by pot and plot experiments, but by the fundamental investigations of plant physiologists who are acquainted with the nature of the soil medium. This point is so important that I venture to illustrate it by the analogy of human medicine. Would you not admit that the only hope of real progress in preventive and curative physic lies in a better understanding of human physiology, rather than in the collection of data, even with the aid of statistical methods, on the reaction of individuals to drugs, diets, and regimes?"

I may be mistaking his scorn of pot and plot experiments and statistical methods, and collections of data, but on what other basis is one to arrive at a solution of the "master-problem of the contract between soil and plant"? Professor Robinson destroys his own argument on page 145 where he deals with the necessity of permanent field experiments on representative soil types for which the soil properties are known. "The soil map is only the first stage: it must be followed up by further work to interpret it *in terms of the actual and potential performance of the soils which it represents.*" The italics are ours. There are admittedly other and more delicate ways of learning something about the fundamental truths of plant physiology, but even these have to be considered in relation to various and specified environments. It is because we cannot sit down and wait until what is sometimes called 'pure' science shall bring in that millennial day when a complete philosophy of soils and plant physiology shall be at our disposal, that empirical attempts to solve immediate problems have to be made, incomplete though they be. Professor Stapledon to whom these letters are addressed thinks this is the harder job of the two according to a recent article in *Science Progress*, (Vol. 32, 1938, 453.)

In the seclusion of a University the philosophic attitude is rightly predominant, but account must be taken of other centres of investigation that have thrust on them the rôle of being oases of scientific endeavour in a desert of un-rationalised opinion and practice. As I write I take at random one of the continually increasing number of queries that accumulate on my desk; "Should prunings be left as mulch on the ground or forked in." What a kaleidoscopic arrangement of conceptions is here involved; the benefits or otherwise of cultivation, the application of the general conception of the nitrogen cycle to a particular case, the bogey of soil erosion. In the face of queries like this there is surely something to be said for active, though limited, experiment and advice.

One further point arises. Professor Robinson writes persuasively about the need for lime. It should be noted by those interested in tea that this section does not apply to our conditions. There is no shadow of doubt that the maintenance of an acid reaction is imperative in tea soils, and that contrary to English experience, liming, as contemplated in temperate agriculture, would be disastrous to our major crop.

For the rest, this attractive and inexpensive book is to be recommended to a wide circle of readers.

T. EDEN.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 25-8-38.

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held in the Committee Room of the Ceylon Chamber of Commerce, Colombo, on Thursday, August 25th, 1938, at 10-45 a.m.

Present.—The Chairman, Tea Research Institute (Mr. James Forbes (Jnr.), the Hon'ble the Financial Secretary, the Director of Agriculture (Mr. E. Rodrigo), the Chairman, Planters' Association of Ceylon (Mr. R. C. Scott), the Chairman, Ceylon Estates Proprietary Association (Mr. R. J. Hartley), Major J. W. Oldfield, C.M.G., O.B.E., M.C., Messrs. I. L. Cameron, J. D. Hoare, Col. T. G. W. Jayewardene, V.D., T. B. Panabokke, and K. W. Taylor, and Dr. R. V. Norris (Director and Secretary).

1. The Notice calling the Meeting was read.

2 The Minutes of the Meeting of the Board held on the 21st April, 1938, were confirmed.

Reported that a letter had been received from Mr. R. G. Coombe expressing inability to attend.

3. MEMBERSHIP OF THE BOARD AND SUB-COMMITTEES

Board.—Reported that:

(a) Mr. K. W. Taylor had been nominated by the Ceylon Estates Proprietary Association to act for Mr. J. C. Kelly on leave with effect from 22nd April, 1938. (Letter dated 22nd April, 1938 from Secretary, C. E. P. A.).

(b) Mr. I. L. Cameron on his return from leave had resumed his place on the Board with effect from 15th July, relieving Mr. C. E. Hawes. (Letter dated 15th July from Secretary, C. E. P. A.).

(c) Mr. D. T. Richards on vacating the Chair of the C. E. P. A. ceased to be an ex-officio member of the Board with effect from 5th August, 1938. Mr. Richards had been succeeded by Mr. R. J. Hartley (Letter dated 6th August, 1938 from Secretary, C. E. P. A.).

The Chairman said he would like to record the thanks of the Board to Mr. Richards and Mr. Hawes for their valuable services to the Institute.

Finance Sub-Committee.—Mr. Forbes proposed from the Chair that Mr. K. W. Taylor be appointed to act on the Finance Sub-Committee during the absence of Mr. J. C. Kelly.—Approved.

Experimental and Estate Sub-Committee.—Reported that Mr. John Horsfall had resigned from this Committee on his retirement from Ceylon. Mr. Richards had been on this Committee as a member of the Board and was willing to continue to serve. The Chairman suggested Mr. Richards be re-elected as an outside member in place of Mr. Horsfall. This was approved.

The Chairman referred to the valuable services to the Institute rendered by Mr. Horsfall who had taken a prominent part in the preliminaries leading to the formation of the Institute. He had been a member of the Experimental Committee since its inception, a member of the Board from 1926-1934, and Acting Chairman in 1926-27.

He moved that the thanks of the Board to Mr. Horsfall for his services be recorded. This was approved with applause.

4. FINANCE

Tea Research Institute Cess.—Reported that the Institute's proposals had been approved by the Council of the Ceylon Association in London on the 13th June.

The Chairman said from reports in the press it appeared the Executive Committee for Agriculture and Lands had also approved the Institute's proposals.

Institute's Accounts to 31st July, 1938.—(i) Reported that of the sum now shown as on Fixed Deposit, Rs. 75,316 would mature in September and would be required for interest charges and Capital redemption on the Government Loan.

(ii) Reported that a further sum of Rs. 25,000 representing instalments up to December 31st, 1938, towards loan charges in 1939, had been placed on fixed deposit with the National Bank of India for 12 months at 1½ per cent.

The Accounts were approved on the motion of Mr. Cameron, seconded by Mr. Taylor.

Resthouse.—The Board confirmed the action of the Finance Sub-Committee accepting the tender of Messrs. M. Y. Hemachandra & Co. for Rs. 18,783 for the construction of the Resthouse and authorised the fixing of the Institute's Seal to the agreement with these contractors.

The Board also sanctioned a vote of Rs. 3,750 for the Resthouse equipment as recommended by the Finance Sub-Committee.

In reply to Col. Jayewardene, the Chairman said that rules for the use of the Resthouse were under consideration.

5. ST. COOMBS ESTATE

(a) *Visiting Agent's Report dated 24th June.*—The Chairman said as the Visiting Agent had paid his visit just after the last meeting of the Estate and Experimental Committee, his report had not yet been before that Committee. It would come up for consideration on the 17th September, the date of the next meeting.

Engine Repairs.—The Board sanctioned an increase in the vote for a new Piston and Liner for No. 2 Engine from Rs. 1,050 to Rs. 1,394, the increase being due to the rise in cost of materials since the estimates were framed.

Latrines.—After considering a letter from the superintendent, the Board decided that the four latrine compartments to be built under this year's estimates should be of the same type as those previously constructed and sanctioned an additional vote of Rs. 120 for this purpose.

(b). *Experimental Manufacture.*—Reported that an invoice of "Clivemeare" tea and an invoice of normal St. Coombs tea, made simultaneously, had been sent to London for report and sale. The Director said arrangements had been made for as many samples as possible of these teas to be distributed.

(c). *St. Coombs-Kowlahena Road.*—The Board sanctioned the fixing of the Institute's Seal to an agreement drawn up between St. Coombs, Kowlahena and Mattakelle estates, implementing the decision previously taken to allow the use of the St. Coombs-Mattakelle Road to Kowlahena estate on payment of an annual contribution towards maintenance costs.

(d). *Insurance.* (i) St. Coombs Factory and Equipment. Reported that in accordance with the instructions of the Board, a fresh valuation had been made of St. Coombs Factory and all machinery. In consequence, the insurance on these items had been increased by Rs. 53,000 to cover present *replacement* value. An additional vote of Rs. 194 was sanctioned to meet the increase in premium.

(ii) *Loss of Profits Insurance.*—The Chairman reported that the Committee recommended that the cover under this policy be increased.

The Board decided to increase the cover to Rs. 82,000.

(e). *Superintendent's Leave and Acting Arrangements.* Reported that Mr. Rogers was due eight months' home leave as from the 12th April, 1939. Agency firms had been invited to submit names for the Acting Superintendentship and twelve names had been received. It was unanimously decided to offer the acting appointment to Mr. N. B. Parker.

6. MINUTES OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE HELD ON 18-6-38

Tea Selection and Import of Tea Seed.—(1). Reported that a preliminaary memorandum by the Plant Physiologist on the subject of tea selection had been issued to members for information. At a

later date, after such revision as proved necessary in the light of further experience, this Memorandum would be printed in *The Tea Quarterly* for general information.

Several members referred to the interest this Memorandum had aroused.

(2). In reply to the Chairman, the Director of Agriculture stated that the amendments to the Plant Pest Ordinance, to enable the Institute to import tea seed from India for experimental purposes, had been approved and would come into force on the 1st October, next.

Foreign Matter in Tea and Factory Hygiene.—The Board sanctioned an additional vote of Rs. 500 for work on Factory Hygiene in St. Coombs factory as recommended by the Experimental and Estate Sub-Committee.

Assessments, Tea Estates.—The Director stated that the resolution of the Experimental and Estate Sub-Committee in reference to the assessments of estates had been forwarded to the Tea Controller through the Ceylon Estates Proprietary Association. The Controller had replied that he was unable to make any allowance for areas being replanted in the case of estates which had applied for reassessment as the law did not permit of this. Estates which were not being reassessed would not, however, be penalised on account of areas cut for replanting.

Tea Chest Industry.—The Director reported that he was in touch with the Forest Department and the Department of Industry, Trade and Commerce in regard to locally made tea chests. He had seen samples of locally made momis and also plywood chests which both seemed promising. It was still necessary to ensure that such local chests were not liable to cause taints and he had agreed to carry out tests for this purpose.

7. SENIOR SCIENTIFIC STAFF

Tea Technologist.—The Board sanctioned nine months' home leave to Mr. Lamb as from 27th September. The following acting arrangements were also approved: Advisory Work to Estates and Factory experimentation to be carried out by the Director; Laboratory investigations to be placed under Mr. Sreerangachar, Research Assistant in the Department of Biochemistry.

8. JUNIOR SCIENTIFIC STAFF

(a). Reported that Mr. B. T. Schuilling had been appointed as from 1st June, 1938, to the post of Field Assistant to the Agricultural Chemist sanctioned by the Board at the last meeting.

(b). Small-holdings Officer, Southern Province. The Chairman said 162 applications had been received for this appointment. Nine of these candidates had been interviewed by the Selection Committee.

The Board agreed unanimously to appoint Mr. F. D. Tillekeratne.

9. WORK ON THE CHEMISTY OF TEA

The Director said he understood that one meeting of the Committee which was considering this question in London had been held. No recommendations had yet reached him.

10. ANY OTHER BUSINESS

Tea Research Institute Conference.—It was decided to hold the next Conference on February 24th & 25th, 1939. A Sub-Committee, consisting of the Chairman, the Chairman, Planters' Association of Ceylon, and the Director, was appointed to consider the arrangements.

The Meeting then concluded with a vote of thanks to the Chair.

ROLAND V. NORRIS,
Secretary.

NOTICES.

The Institute's Laboratories and Offices are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station c/o Messrs. Hemachandra & Co., Forwarding Agents.

Visitors' Day.—The *last* Wednesday in each month has been set aside as Visitors' Day at St. Coombs Estate and also at the T. R. I. Sub-Station, Gonakelle Estate, Passara, when it is hoped anyone interested will visit the Stations.

Visitors at other times are welcomed, but it is requested that an appointment be made if possible.

ROLAND V. NORRIS,
Director.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL

(A) Representing the Planters' Association of Ceylon :—

(1) Mr. R. G. Coombe

(2) Mr. Jas. Forbes (Jnr.), (Chairman)

(3) Mr. J. D. Hoare

(B) Representing the Ceylon Estates Proprietary Association :—

(4) Major J. W. Oldfield, C.M.G., O.B.E., M.C.

(5) Mr. I. L. Cameron (on leave) Mr. C. E. Hawes (acting).

(6) Mr. J. C. Kelly (on leave) Mr. K. W. Taylor (acting).

(C) Representing the Low-Country Products' Association :—

(7) Mr. S. F. H. Perera

(D) Representing the Small-Holders :—

(8) Mr. T. B. Panabokke

(E) Ex-Officio Members :—

(9) The Hon. the Financial Secretary.

(10) The Director of Agriculture

(11) The Chairman, Planters' Association of Ceylon

(12) The Chairman, Ceylon Estates Proprietary Association

Secretary, Roland V. Norris, D.Sc., St. Coombs, Talawakelle.

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The publications of the Tea Research Institute will be sent, free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to Estate Agencies dealing with Ceylon tea, if they register their names and addresses with the *Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle.*

Other persons can obtain the publications of the Institute on application to the Director, the subscription being Rupees fifteen per annum for persons resident in Ceylon or India, and £1-5-0 for those resident elsewhere. Single numbers of *The Tea Quarterly* can be obtained for Rs. 2-50 or 4*s*. In the case of Indian cheques four annas should be added to cover commission.